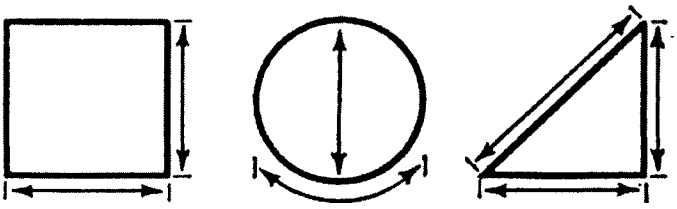
DEPARTMENT OF DEFENSE • OFFICE OF CIVIL DEFENSE

FAMILY SHELTER DESIGNS



H-7

GENERAL INFORMATION

This handbook contains instructions for building eight types of family fallout shelters. The shelters were designed for construction in backyards and basements, and for use by families who do not have access to community shelters or who prefer that their shelters be at their homes.

The following considerations apply to the shelters described in this handbook:

Fallout Protection Factor.—If properly constructed, all the shelters have a fallout radiation protection factor of at least 100—the minimum recommended by the Department of Defense. A protection factor expresses the relation between the amount of fallout radiation that would be received by an unprotected person compared to the amount he would receive if he were inside a shelter. For example, a completely unprotected person would be exposed to 100 times more radiation than a person inside a shelter with a protection factor of 100.

Space.—In determining the minimum amount of shelter space per person, ventilation factors have been taken into consideration. Also, the assumption has been made that short, necessary trips could be made from shelters a few days after an attack, and that the shelters could serve as living quarters for at least 2 weeks if necessary. Some of the shelters provide space for only three persons. However, the persons are considered to be adults, and a "three-person shelter" could provide space for two adults and two small children.

Construction Costs.—Most of the shelters in this booklet were designed to keep construction costs at a minimum in order to bring home shelters within the reach of as many families as possible. For this reason most of the designs depend upon do-it-yourself construction. Cost estimates for individual shelters are based upon national averages and are subject to local variations.

Fire Resistance.—If properly constructed, shelters—as structures—have considerable resistance to external fire hazards. But whether they would be habitable if there are fires in the area would depend upon the intensity of heat and smoke entering the shelters—conditions which would be largely determined by surrounding burnable material. Measures to reduce fire risk under nuclear attack are under study by the Department of Defense.

Drainage.—Precautions should be taken to insure that underground shelters remain reasonably dry. These include such measures as sloping the ground away from the shelter and digging drainage gutters. Since drainage problems differ at various locations, you should seek local guidance on the subject before constructing an underground shelter.

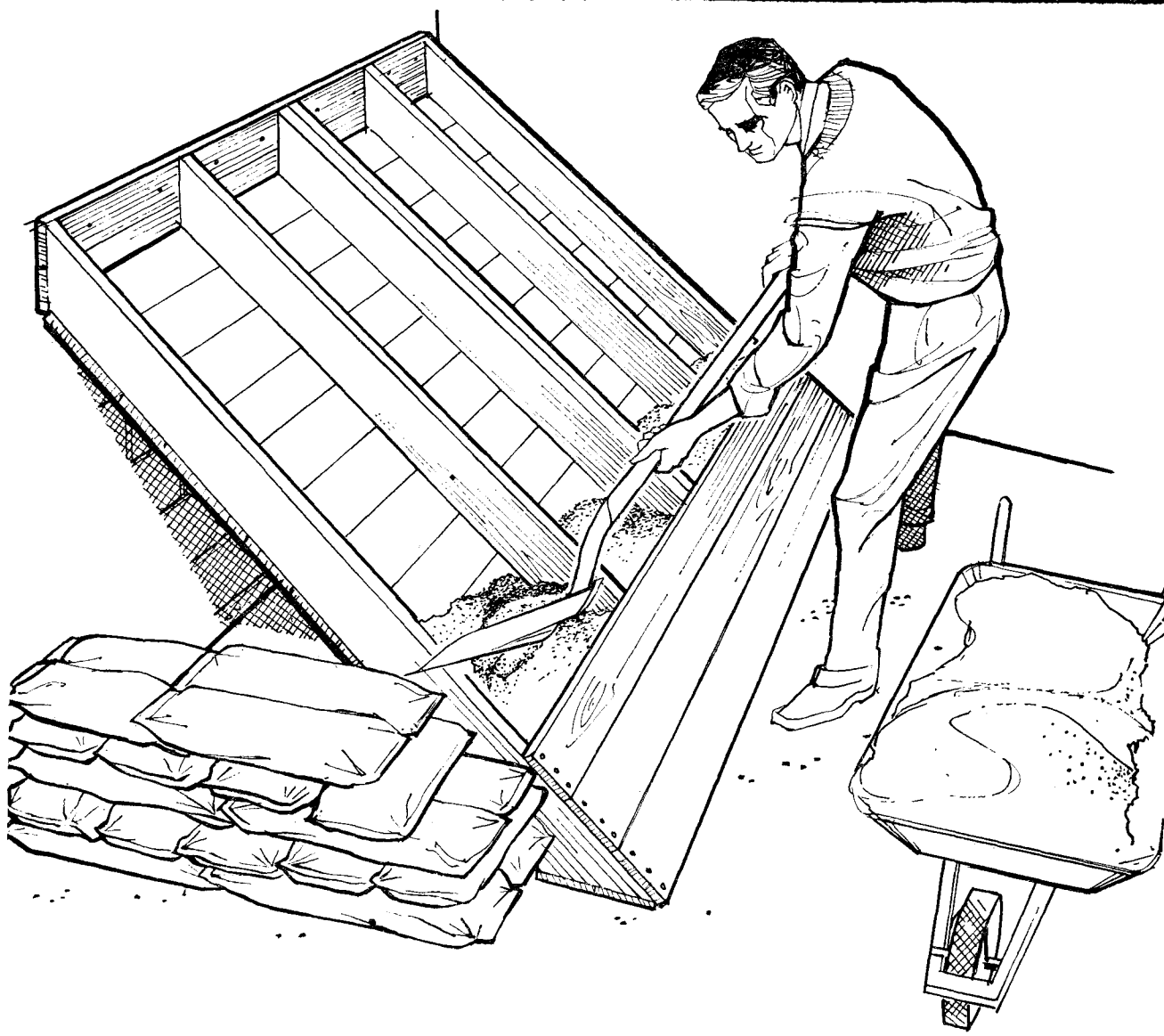
Among those consulted in the preparation of the shelter designs in this handbook were members of the Subcommittee on Protective Structures of the Advisory Committee on Civil Defense, National Academy of Sciences; and engineering specialists from organizations associated with the principal materials to be used in constructing the shelter. Further information is available from American Iron & Steel Institute, Douglas Fir Plywood Association, Asbestos Cement Product Association, National Concrete Masonry Association, National Lumber Manufacturers Association, Structural Clay Products Institute, American Concrete Pipe Association, and the Portland Cement Association.

In building any of the shelters, modifications may have to be made to suit local building codes. If modifications are necessary, they should be checked with local civil defense authorities before starting construction.

JANUARY 1962.
(Reprinted March 1962)

CONTENTS

Basement Sand-Filled Lumber Lean-To Shelter

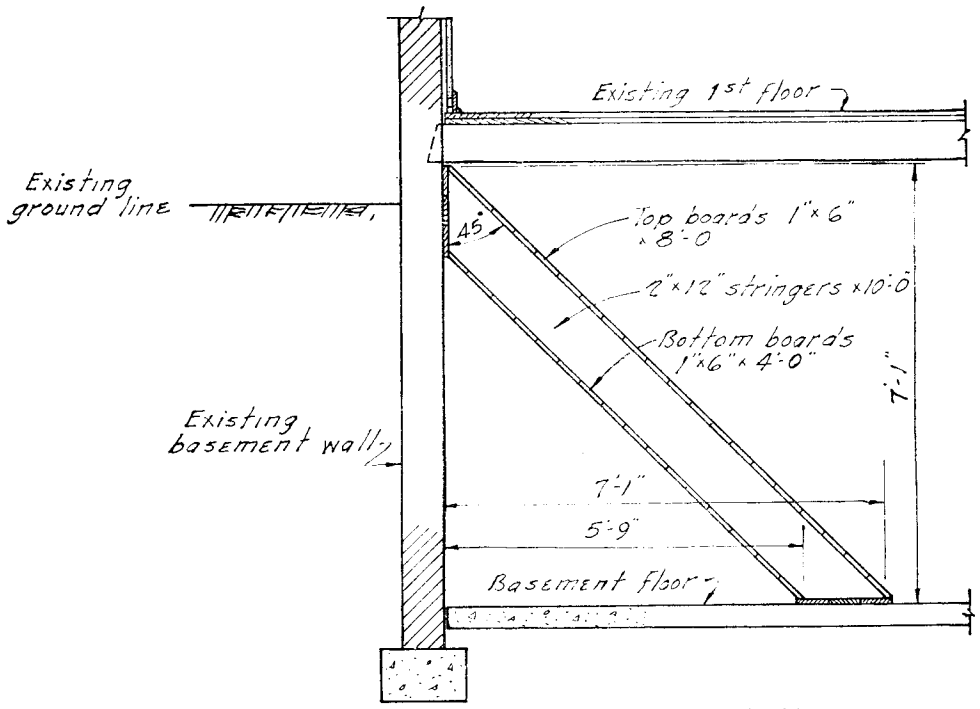


GENERAL INFORMATION

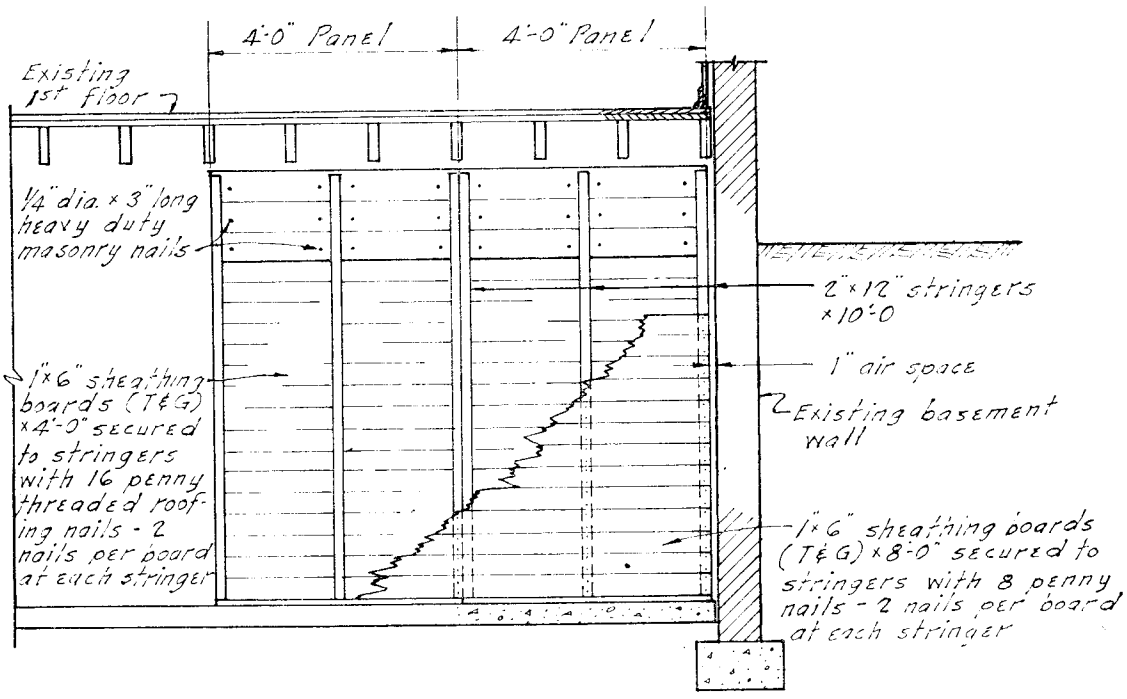
This shelter is designed to provide protection from the effects of radioactive fallout in the belowgrade basement of an existing structure. Its advantages are low cost, simplicity of construction, general availability of materials, and the fact that it may be easily disassembled.

TECHNICAL SUMMARY

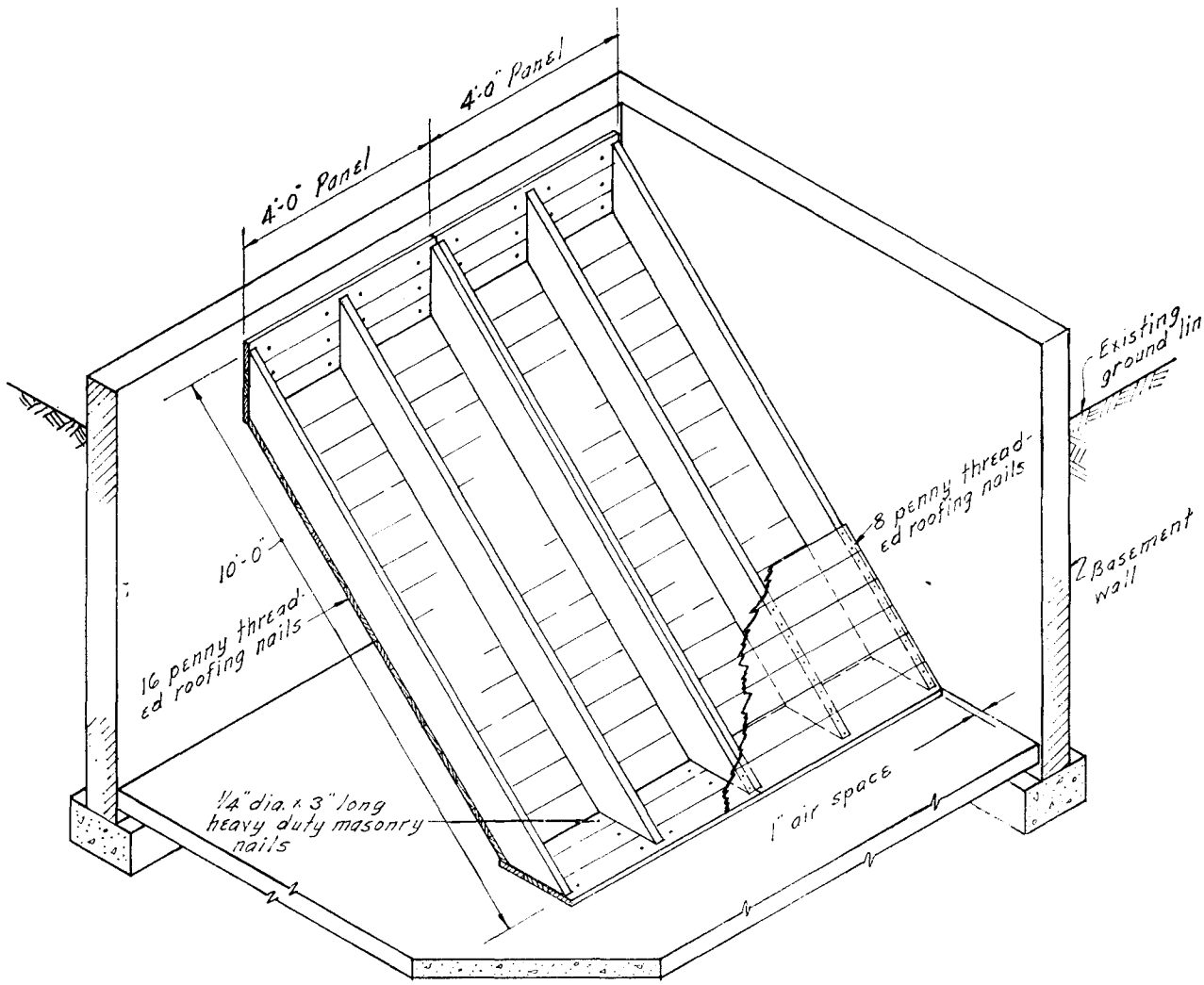
Space and Occupancy.—This shelter design will provide 45 square feet of area and approximately 128 cubic feet of space. It will house three persons. The shelter length can be increased by increments of 4-foot panels. The height may be increased by the use of more materials. This



SECTION



ELEVATION



ISOMETRIC VIEW

increase will be limited by basement height and handling of the panels.

Availability and Cost of Materials.—The materials necessary to construct this shelter should be available for a total cost of less than $75 from retail lumberyards.

Fallout Protection Factor.—The shelter is designed to provide a protection factor of at least 100 in most residences.

Blast Protection.—Although this shelter was designed primarily to provide fallout protection, it would also provide some protection from flying debris associated with blast.

Ventilation.—Natural ventilation is obtained by omitting two sandbags from the top of the entranceway closure and by leaving a 1-inch gap between the end of the shelter and the basement wall.

Construction Time.—Construction time should not exceed 20 man-hours when all the materials are on hand at the shelter location. The use of precut panels would reduce the erection time.

Structural Life Expectancy.—When this shelter is erected in a dry basement which is kept free of vermin, its life expectancy range should be from 10 to 15 years.

CONSTRUCTION SEQUENCE

1. Brush-coat all surfaces of lumber with water repellant solution; double brush-coat all cut edges. (Optional.)
2. Cut 45° bevels on 2″ x 12″ stringers. Arrange in 4-foot panels. Using sixteenpenny threaded nails, attach bottom boards on the beveled ends first.
3. Fit in and nail remaining bottom boards.
4. Turn this panel rightside-up and place it in its permanent position. Fasten the panel to the wall and floor with heavy duty masonry nails, leaving a 1-inch gap between the end of the shelter and the basement wall.
5. Construct and fasten in sequence as many panels as are to be used.
6. Line the panels with building paper or polyethylene.
7. Using eightpenny nails, begin attaching top boards at the floor first. Keep the spaces thus formed filled with loose sand as the top-board application progresses. (Building paper or polyethylene sheet should also be applied between the sand and top boards.)
8. Thirty sandbags, each filled with 30 pounds of sand, should be placed in the shelter for emergency closure of entranceway.

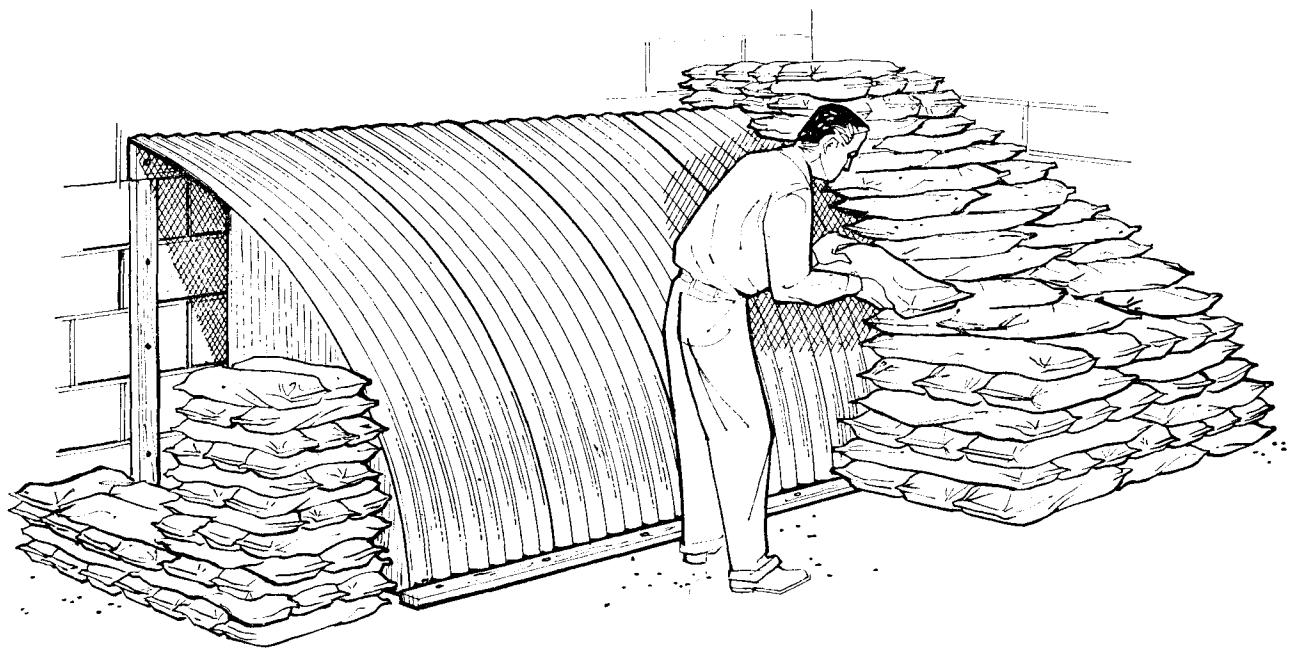
BILL OF MATERIALS

(To shelter 3 persons)

Item	*Quantity*
2″ x 12″ x 10′ rough or surfaced lumber	6 pieces.
1″ x 6″ x 4′ rough or surfaced lumber	50 pieces.
1″ x 6″ x 8′ rough or surfaced lumber (for top covering)	20 pieces.
¼″ diameter x 3″ long heavy-duty masonry nails	2 pounds.
Sixteenpenny threaded roofing nails	6 pounds.
Eightpenny threaded roofing nails	3 pounds.
Dry sand	5½ tons.
Sandbags	30.
Building paper or polyethylene sheet	150 square feet.
Water repellent* (5 percent pentachlorophenol or equal) toxic to wood-destroying fungi and insects.	1 quart.

*Optional.

Basement Corrugated Asbestos-Cement Lean-To Shelter

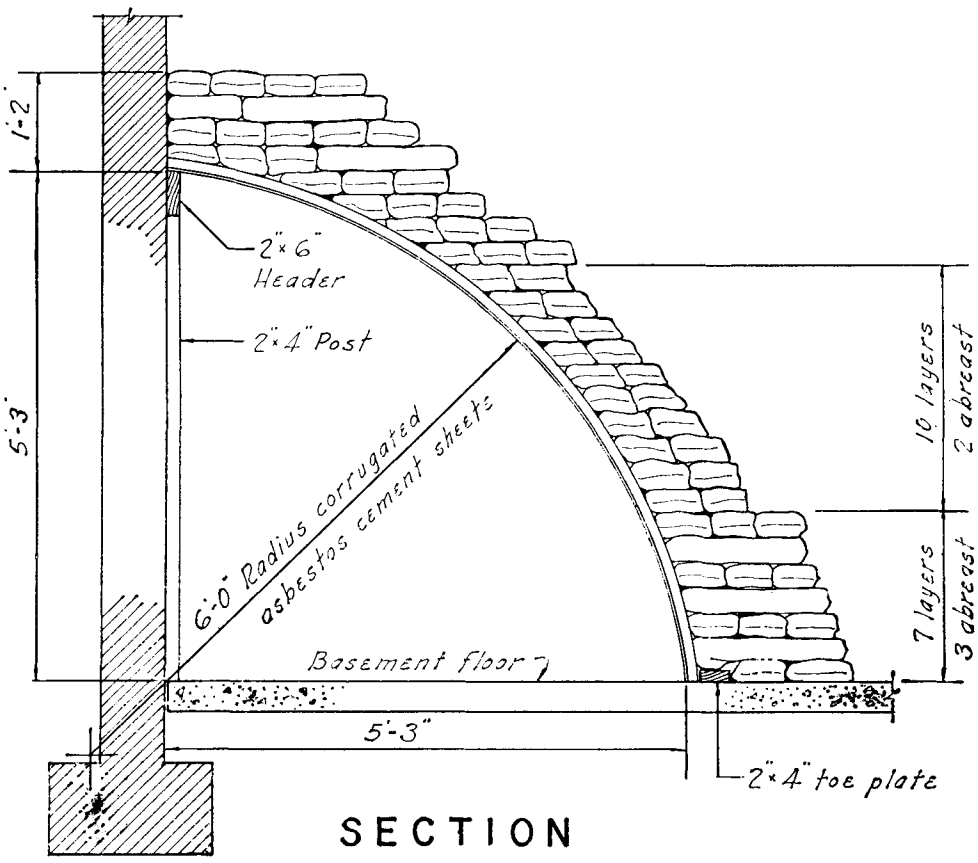


GENERAL INFORMATION

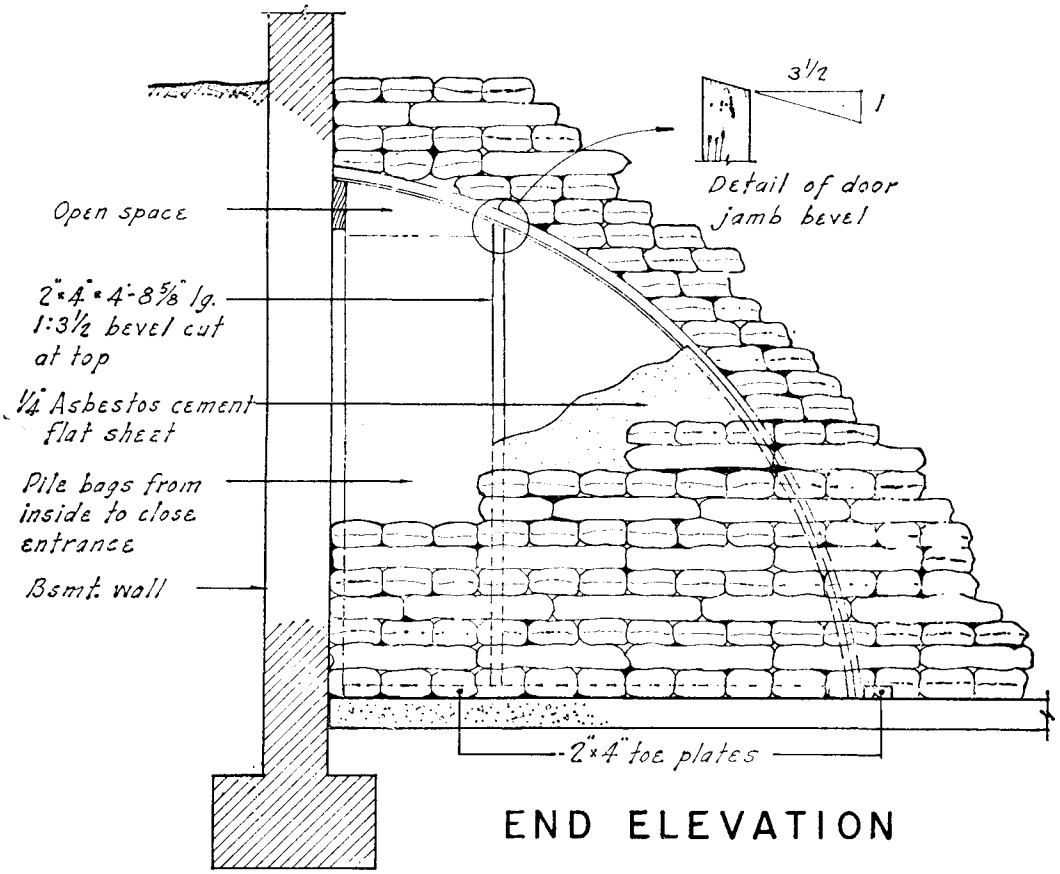
This shelter is designed to provide low-cost protection from the effects of radioactive fallout. It is intended to be installed belowgrade in a basement area. Its principal advantages are availability of low-cost materials, adaptability to the dimensions of most basements, ease of construction, and it can be disassembled readily.

TECHNICAL SUMMARY

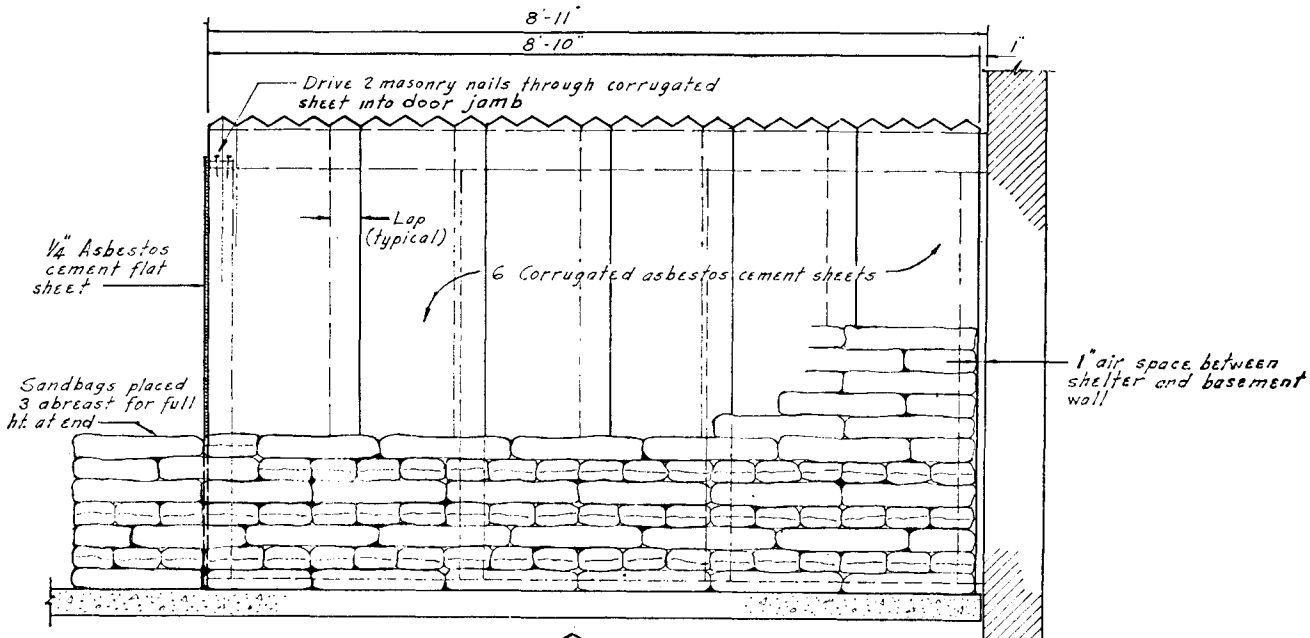
Space and Occupancy.—The lean-to shelter interior has over 40 square feet of area and over 120 cubic feet of space and will house three persons. Its length may be extended by adding sections.
Availability and Cost of Materials.—Materials may be purchased from building materials retailers. Many of these have this shelter in kit



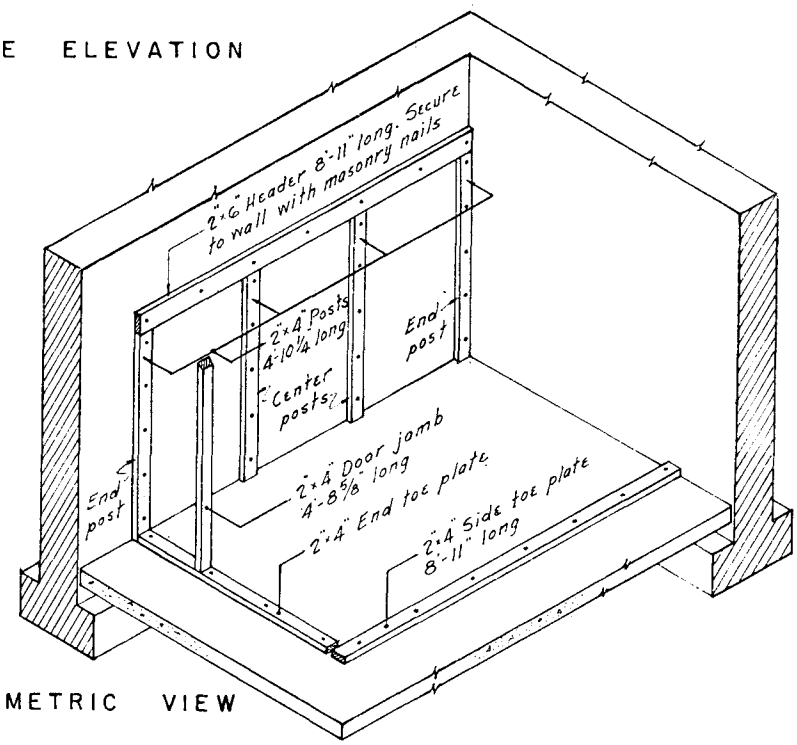
SECTION



END ELEVATION



SIDE ELEVATION



ISOMETRIC VIEW

form at a price of about $125. The entire kit is transportable in an average-sized station wagon and can be carried through standard-sized doorways, hallways, and window openings.

Fallout Protection Factor.—The shelter is designed to provide a protection factor of at least 100 in most residences.

Blast Protection.—Although this shelter was designed primarily to provide fallout protection, it would also provide some protection from flying debris associated with blast.

Ventilation.—Natural ventilation is obtained by omitting two sandbags from the top of the entranceway closure and by leaving a 1-inch airgap along the rear wall. (See Construction Sequence, steps 2 and 12.)

Construction Time.—Total construction time is approximately 18 man-hours: 2 hours for construction of the shell and 16 hours for filling and stacking the sandbags.

Structural Life Expectancy.—The range is from 10 to 20 years, depending on the level of humidity in the basement.

CONSTRUCTION SEQUENCE

1. Brush-coat all surfaces of lumber with water-repellent solution; double brush-coat all cut edges.
2. Nail the 2″ x 6″ header and the 2″ x 4″ end-posts in place with masonry nails. Leave 1″ airspace for ventilation between end of shelter and basement wall.
3. Mark off header into equal distances and nail centerposts in place.
4. Place curved corrugated asbestos-cement sheets in place with one corrugation overlapping. Rest top of curved sheets on the 2″ x 6″ header.
5. Place 2″ x 4″ toeplate firmly against bottom edge of curved corrugated sheets. Nail toeplate to concrete floor with masonry nails.
6. Nail end toeplate in place.
7. Put the 2″ x 4″ doorjamb in place with the 1:3½ bevel on the top end against the curved corrugated sheet. Drive two masonry nails through the corrugated sheet into the doorjamb.
8. Nail precut asbestos-cement flat sheet to doorjamb and toeplate—making sure flat sheet has solid bearing against curved corrugated sheet as well as doorjamb and toeplate.
9. Fill each sandbag with about 30 pounds of sand and tie securely with wire ties.
10. Stack sandbags three abreast in lowest seven layers around the entire length and entrance end of the shelter with every other layer perpendicular to the corrugated sheets. Start at the end of the shelter where the 1-inch airspace occurs and stagger the bags so that all joints are broken, as in brick wall construction. Partly filled bags will be required to form corners and ends.
11. Continue to stack the bags for the next 10 layers along the length and the end of the shelter, leaving the entranceway open. Bags should be placed two abreast and joints staggered. Enough bags should be laid on top of the shelter to provide 14-inch depth.
12. The remaining bags of sand are placed inside the shelter to be stacked in the entranceway for emergency closure. Omit two bags at the entranceway top for ventilation during shelter use.

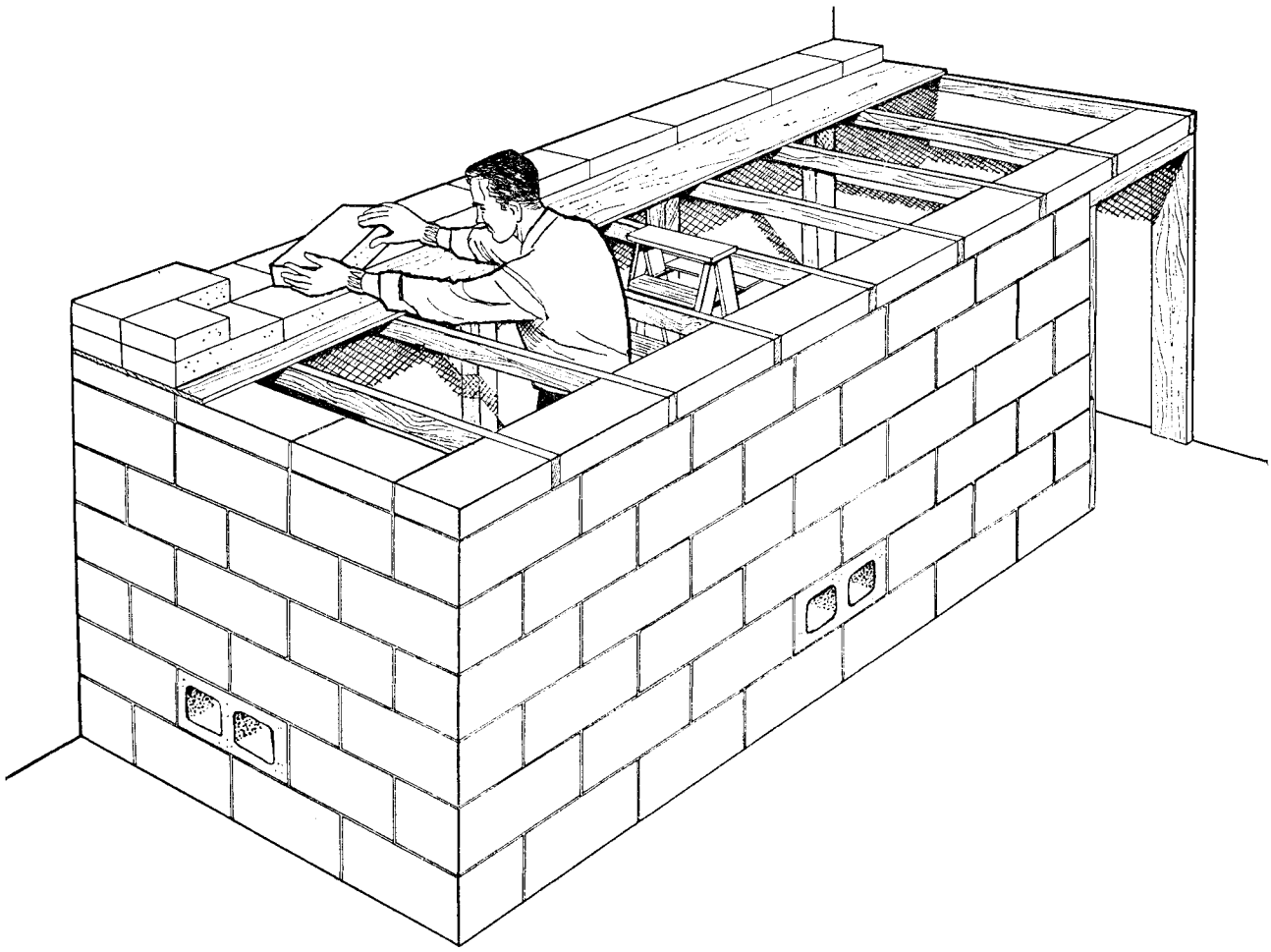
BILL OF MATERIALS

(To shelter 3 persons)

Item	*Quantity*
2″ x 4″ x 58¼″ construction grade fir or equal	5 pieces.
2″ x 6″ x 8′11″ construction grade fir or equal	1 piece.
2″ x 4″ x 8′11″ construction grade fir or equal	1 piece.
2″ x 4″ x 56⅝″ construction grade fir or equal (1:3½ bevel on one end).	1 piece.
Water repellent (5 percent pentachlorophenol or equal), toxic to wood-destroying fungi and insects.	1 quart.
3″ spiral-type tempered masonry nails	¾ pound.
43½″ x 59½″ x ¼″ asbestos-cement sheet, cut to 6′ radius	1 piece.
Corrugated sheets, asbestos-cement, curved (6′ radius) 21″ wide x 96″ long.	6 sheets.
9″ x 23″ x 0.004″ polyethylene sandbags with wire ties	650.
Dry sand	10 tons.

FAMILY SHELTER SERIES PSD F-61-3

Basement Concrete Block Shelter

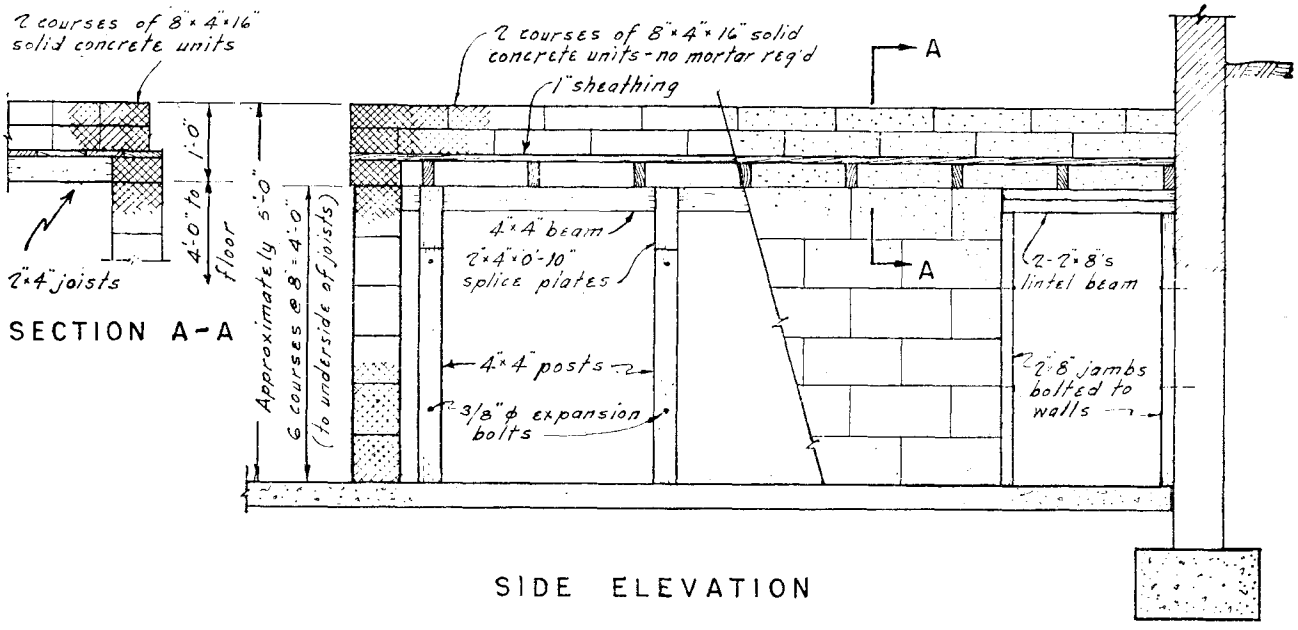


GENERAL INFORMATION

This concrete block basement compact shelter will provide low-cost protection from the effects of radioactive fallout. It is intended to be installed belowgrade in a basement. Its principal advantages are simple design, speed of construction, and ready availability of low-cost materials. By increasing the ceiling height to 6 feet or more, it could also serve as a dual-purpose room.

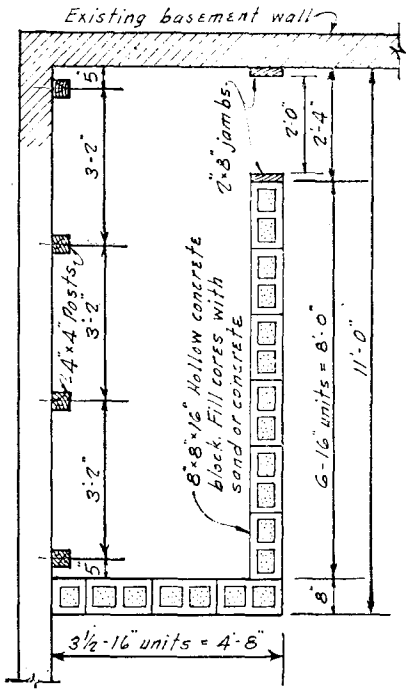
TECHNICAL SUMMARY

Space and Occupancy.—This shelter has about 52 square feet of area and 260 cubic feet of space and will provide shelter for four persons.

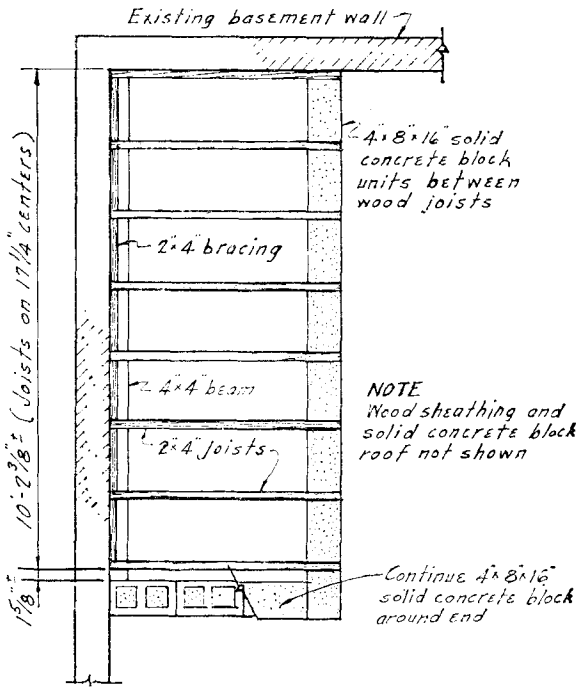


SECTION A-A

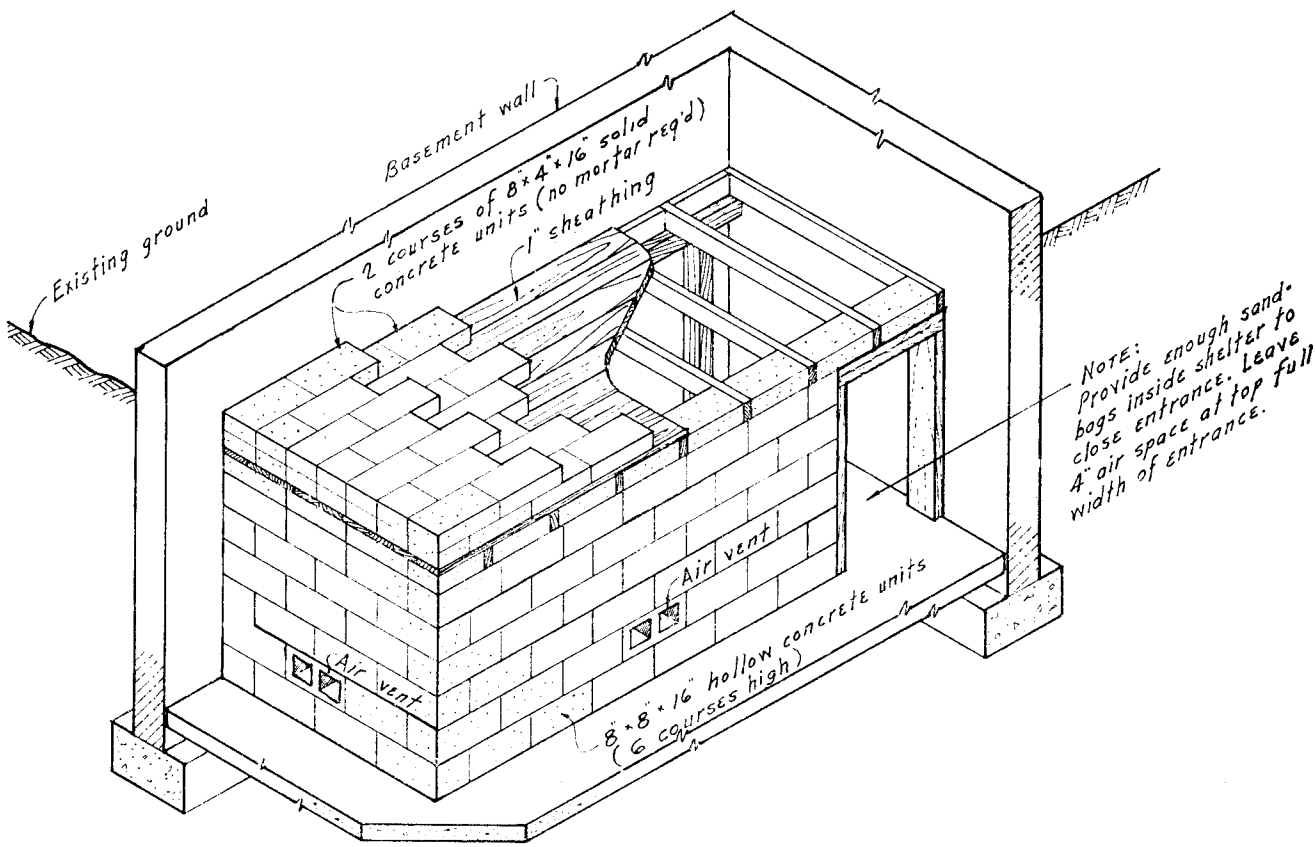
SIDE ELEVATION



FLOOR PLAN



ROOF FRAMING PLAN



ISOMETRIC VIEW

Availability and Cost of Materials.—Most of the materials required to build this shelter are obtainable at local concrete-block plants and lumber yards. The cost of the materials for the basic shelter is estimated at $75 per shelter.

Fallout Protection Factor.—In most residences, the shelter will provide a protection factor of at least 100.

Blast Protection.—Although this shelter was designed primarily to provide fallout protection, it would also provide some protection from flying debris associated with blast.

Ventilation.—Natural ventilation is provided by the airspace left at the entranceway after emergency closure, and the air vents in the shelter wall.

Construction Time.—Estimated construction time for the basic shelter is less than 20 man-hours.

Structural Life Expectancy.—The life expectancy of the shelter would be about the same as most types of residences.

CONSTRUCTION SEQUENCE

1. Lay out guidelines with chalk on basement floor for shelter walls. (See floor plan.)
2. Lay first course of block in a full bed of mortar. Vary thickness of mortar bed if basement floor is not level.
3. Continue to lay wall blocks. Corner of wall should be built up first, about three or four courses high, before laying blocks in remainder of wall. All blocks should be laid in a full bed of mortar. Where 8-inch blocks are required, cut 16-inch units in half with a hammer and chisel.
4. Fill cores of blocks with sand (or concrete) after three courses have been laid up.
5. Continue procedures indicated above in steps 3 and 4 until walls have been laid up to a height of 4 feet (six courses), and all cores have been filled with sand (or concrete).
6. Brush-coat all surfaces of lumber with water-repellent solution. Double brush-coat all edges. (Optional procedures. Desirable for wood preservation.)
7. Fasten wood posts and doorjambs to existing basement walls and shelter walls with expansion bolts. Use two bolts per post. (See side elevation.)
8. Place wall beam and door lintel beam in position and secure to posts with nails.
9. Place wood joists and bracing in position and secure together with nails. (See roof framing plan.)
10. Place portion of wood sheathing on top of joists. Nail wood sheathing to joists. (See isometric view.)
11. Place solid concrete masonry units on top of wood sheathing. No mortar is required between these units.
12. Continue procedures indicated above in steps 10 and 11 until roof covering has been completed.
13. Bags of sand or additional solid concrete blocks should be stored near entrance for emergency closure, but airspace of at least 4 inches should be left at top of closure for ventilation and air circulation.

BILL OF MATERIALS

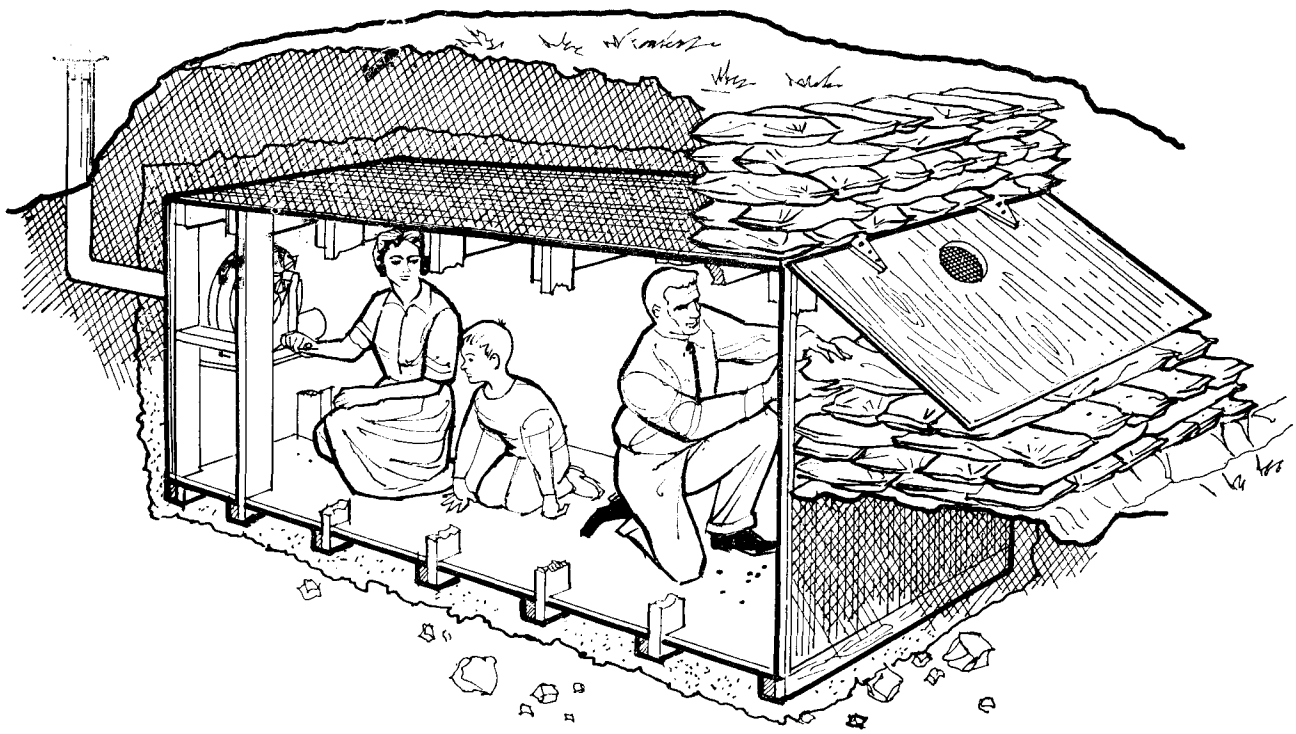
(Ceiling height 4 feet)

Item	*Quantity*
8″ x 8″ x 16″ hollow concrete masonry units*	65.
8″ x 4″ x 16″ solid concrete masonry units*	135.
Mortar (prepared dry mix)	5 cubic feet.
Sand or concrete (for filling cores)	1 ton.
Sandbags	30.
4″ x 4″ x 3′8″ wood posts (structural grade)	4.
2″ x 8″ x 3′8″ wood posts (structural grade)	2.
2″ x 8″ x 2′4″ wood beam (structural grade)	2.
4″ x 4″ x 10′3″ wood beam (structural grade)	1.
1″ wood sheathing	52 board feet.
2″ x 4″ x 4′8″ wood joists (structural grade)	8.
4″ x 4″ x 10′3″ wood beam (structural grade)	8.
2″ x 4″ wood bracing (structural grade)	10 linear feet.
⅜″ x 7″ expansion bolts	12.
Sixteenpenny nails	2 pounds.
Sixpenny nails	2 pounds.
Water repellent (5 percent pentachlorophenol or equal), toxic to wood-destroying fungi and insects.**	1 quart.

*Units should be made with concrete having a density not less than 130 pounds/cubic feet.

**Optional.

Outside Semimounded Plywood Box Shelter



GENERAL INFORMATION

This shelter is designed to provide low-cost protection from the effects of radioactive fallout. Its principal advantages are ready availability of low-cost materials, ease and speed of construction, protection from fallout radiation, and limited blast resistance.

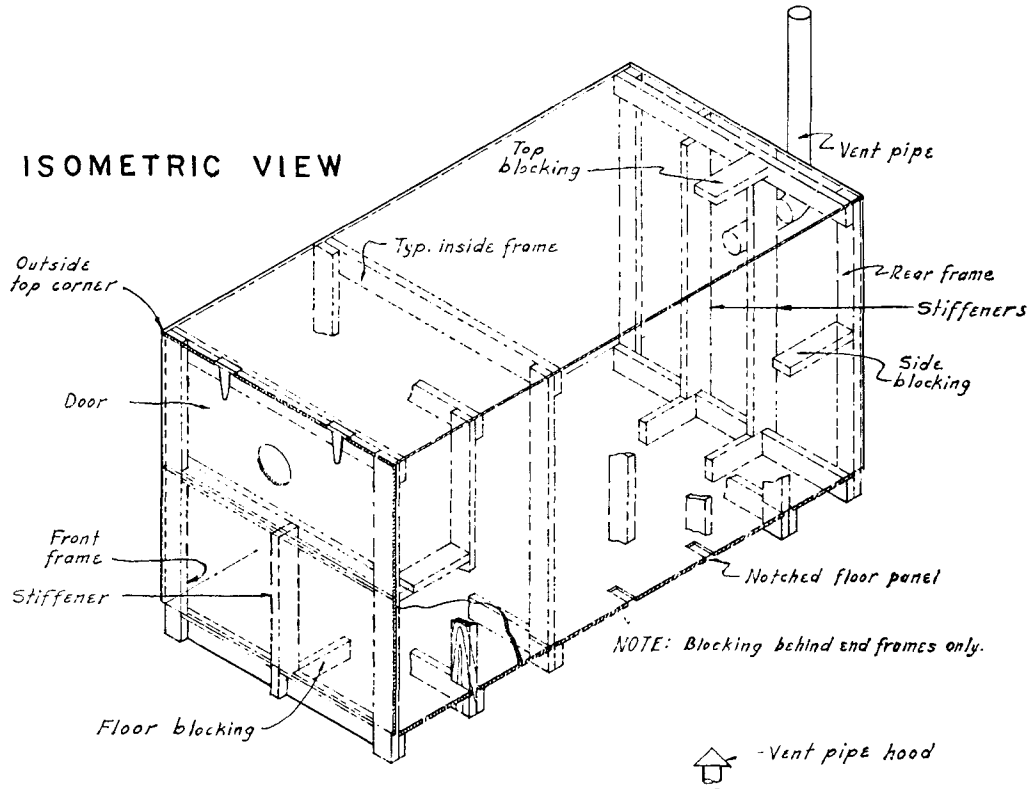
TECHNICAL SUMMARY

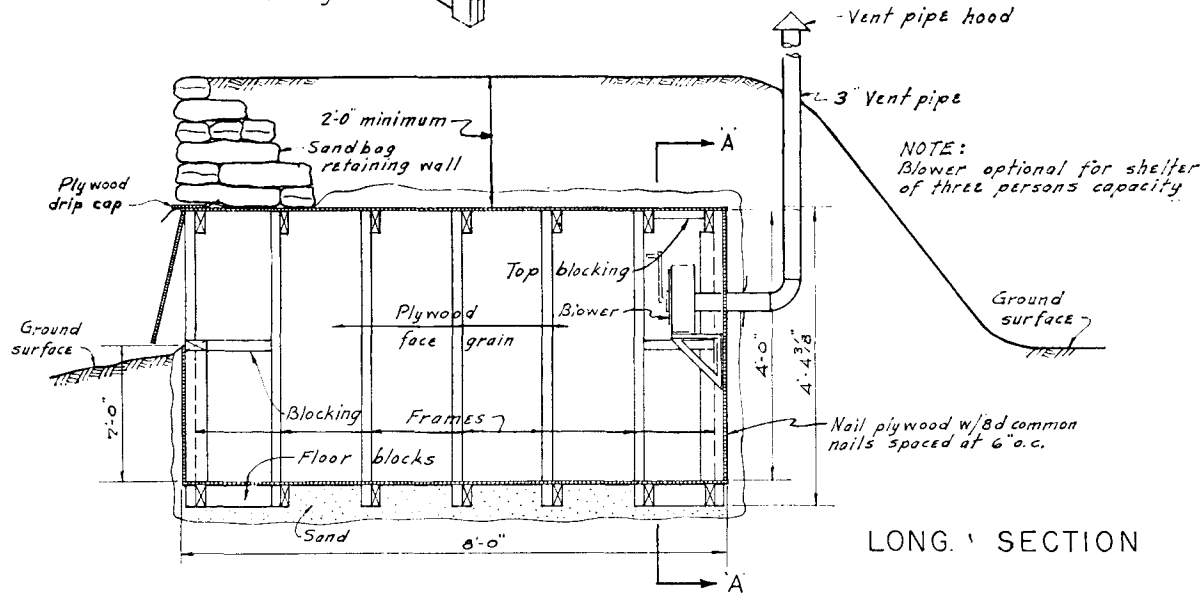
Space and Occupancy.—The shelter in this design has 32 square feet of area and 128 cubic feet of space and will house three persons. See "*NOTE*" after "Construction Sequence" for description of a size to house more persons.

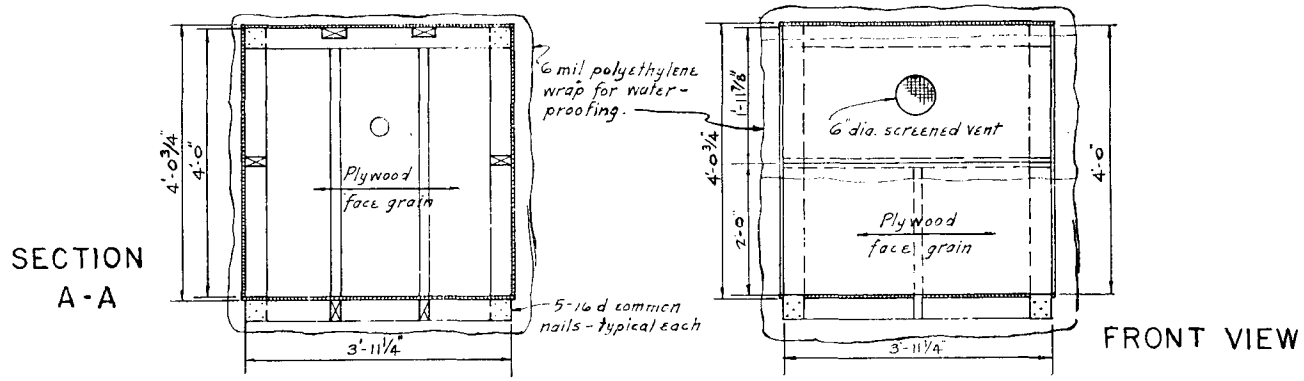
Availability and Cost of Materials.—Most of the materials needed to build this shelter are obtainable at lumberyards. The nationwide average for cost of materials is about $75 per shelter, not including ventilation equipment.

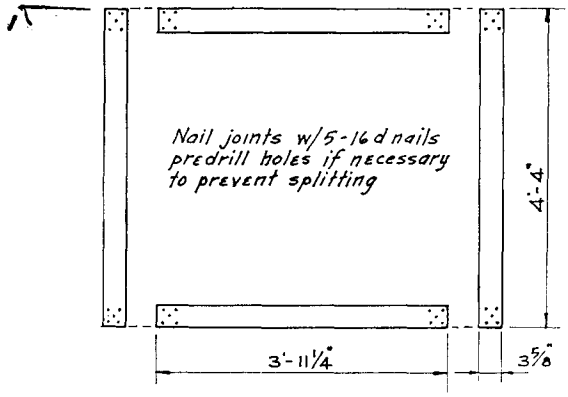
Fallout Protection Factor.—A protection factor of about 500 is obtained if the earth cover is 2 feet deep, and a 2-foot thick entranceway shield is formed with bags of sand.

Blast Protection.—The shelter should be able to withstand a limited blast overpressure of 5 pounds per square inch.

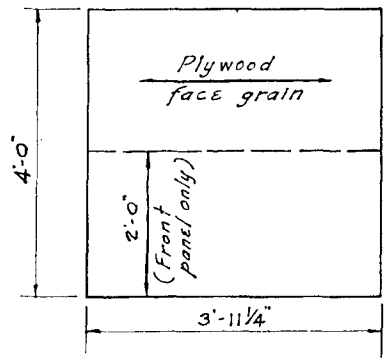

ISOMETRIC VIEW
Top blocking
Vent pipe
Typ. inside frame
Outside top corner
Rear frame
Stiffeners
Side blocking
Door
Front frame
Stiffener
Notched floor panel
NOTE: Blocking behind end frames only.
Floor blocking


Vent pipe hood
3" Vent pipe
2'-0" minimum
Sandbag retaining wall
A
NOTE: Blower optional for shelter of three persons capacity
Plywood drip cap
Top blocking
Plywood face grain
Blower
Ground surface
Ground surface
4'-0"
4'-4 3/8"
2'-0"
Blocking
Frames
Nail plywood w/8d common nails spaced at 6" o.c.
Floor blocks
Sand
8'-0"
A
LONG. SECTION

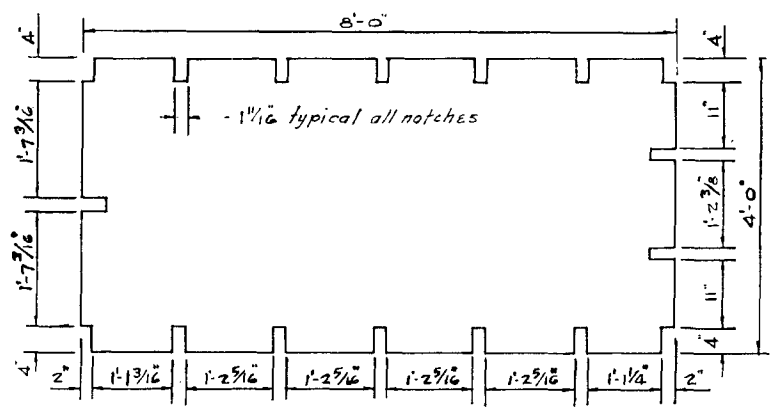

SECTION A-A
4'-0 3/4"
4'-0"
Plywood face grain
6 mil polyethylene wrap for water-proofing.
5-16 d common nails - typical each
3'-11 1/4"
1'-11 7/8"
6" dia. screened vent
4'-0 3/4"
4'-0"
2'-0"
Plywood face grain
3'-11 1/4"
FRONT VIEW



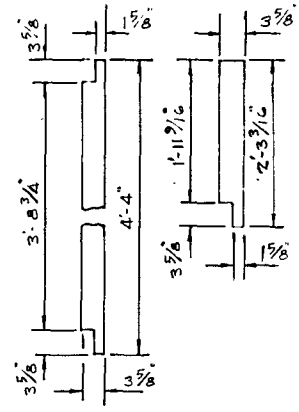
FRAME DETAIL



END PLYWOOD DETAIL



FLOOR PANEL DETAIL



STIFFENER DETAILS

Ventilation.—A 3-inch vent at the rear of the structure provides an essential opening to which a pipe extension can be attached. Hand-operated ventilation equipment should be used for more than three persons. The additional cost may be from $30 to $50. Air is exhausted through the airspace left in the entranceway closure.

Construction Time.—Tests have shown that one man working with simple excavating and construction tools can perform all necessary work in 20 man-hours. This time will be lessened by about 5 hours if lumberyards provide prefabricated plywood panels and sections.

Structural Life Expectancy.—The range is from 5 to 10 years depending on the humidity in the area, drainage characteristics of the terrain, and the effectiveness of the wood treatment (dip preferred) and the plastic wrapping.

CONSTRUCTION SEQUENCE

1. Cut plywood and lumber to size and notch before treating.
2. Dip lumber for 2 minutes or more in water repellent. A trough can be fashioned from a piece of polyethylene film and scrap lumber. Dip plywood in water repellent or give thorough brush treatment. Double brush-coat all cut edges.
3. Assemble the seven frames. (See longitudinal section drawing.)
4. Select a well-drained site. Excavate hole deep enough so that shelter floor will be at least 2 feet below ground surface and wide enough to permit nailing of plywood sides to frames from outside. Slope bottom of the trench so that shelter will be 2 inches higher at entrance than at rear. Lay a 2-inch sandbed for polyethylene moisture barrier.

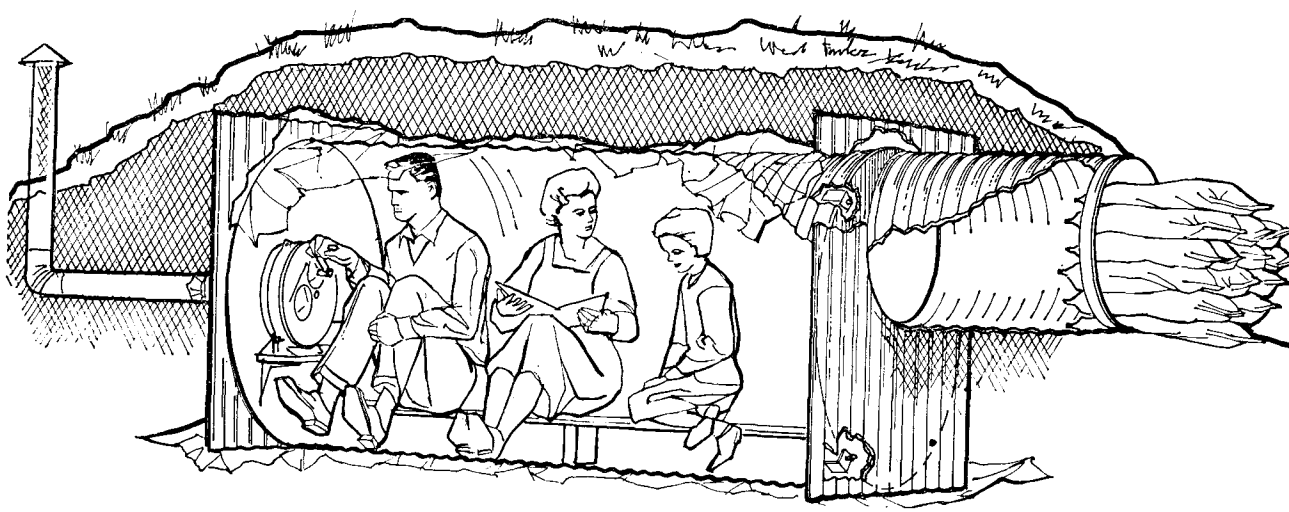
5. Place polyethylene moisture barrier in excavation and cover bottom with a 4-inch layer of sand to prevent frames from breaking barrier. (Sec. A–A, Front View.)
6. Cut three floor blocks to size and tack to underside of floor panel. Place the seven frames approximately in place, imbedded so that the sand will be flush with the underside of the floor panel. Then pass the floor panel inside the frames and nail in place.
7. Toe the end and side panels on the edges of floor panel and nail securely; then nail the side and top blocking, and finally, nail the top panel overlapping both the side and end panels.
8. Pad the outside top corners of the shelter to prevent damage to the polyethylene moisture barrier. Wrap the shelter with the polyethylene.
9. Backfill with 2 feet of earth cover after forming a sandbag retaining wall over the entrance (see longitudinal section) and alongside entranceway.
10. Provide enough filled sandbags or solid concrete blocks for a closure 2 feet thick in the entrance.
11. As an alternative to digging a large hole as described in step 4 above, a somewhat smaller hole can be used if the shelter is assembled above ground and lowered gently into the hole. The shelter weighs approximately 400 pounds complete, or 260 pounds without ends and top. Care must be taken to avoid puncturing the polyethylene moisture barrier.
12. If blower is installed, it should be supported by blocking, or by a frame attached to the end panel with 2″ x 4″ stiffeners.

NOTE: The size of the shelter may be increased in width and height. There is no arbitrary limit to length but the plywood sheets must butt each other at a frame. To increase the width from 4′ to 6′ use 2″ x 6″ ceiling joists. To increase the width from 6′ to 8′ use 2″ x 8″ ceiling joists. To increase the height from 4′ to 6′ use 2″ x 6″ wall studs and floor joists. When increasing height or width the ceiling joists should rest directly on the wall studs and be secured to them by means of nailed ⅜-inch plywood gussets. Ceiling joists require a gusset on one side only. Floor joists require a gusset on each side. Use 12 sixpenny nails in each gusset. Six nails should be used in each of the joined pieces.

BILL OF MATERIALS
(For 4′ x 8′ size)

Item	*Quantity*
⅜″ exterior plywood (Federal specification CS 45–60) or ½″ exterior plywood (Federal specification CS 122–60, group 1 or 2).	5 sheets.
2″ x 4″ x 10′ construction grade Douglas fir or equal	8 pieces.
2″ x 4″ x 8′ construction grade Douglas fir or equal	8 pieces.
4″ x 4′ plywood lumber (drip cap)	1 piece.
9 mil polyethylene film (16′ width)	20 feet.
Water repellent (5 percent pentachlorophenol or equal), toxic to wood-destroying fungi and insects.	2 gallons.
Eightpenny galvanized common nails	4 pounds.
Sixteenpenny galvanized common nails	3 pounds.
3″ diameter galvanized vent pipe	3½ feet.
Vent pipe cap	1.
3″ diameter 90° elbows	2.
Galvanized hinges	1 pair.
Flyscreen 7″ x 7″	1.
Sandbags	58.
Dry sand	3 tons.
Blower (optional, to be used with vent pipe, for 3-person size).	1.
Soil or sand (for shelter cover)	5 cubic yards.

Belowground Corrugated Steel Culvert Shelter



GENERAL INFORMATION

This shelter is designed to provide low-cost protection from the effects of radioactive fallout. Its principal advantages are that most of the structure is generally available as a prefabricated unit ready for lowering into an excavation and that it requires only simple connections and covering to complete the installation.

TECHNICAL SUMMARY

Space and Occupancy.—This shelter has 32 square feet of area and about 120 cubic feet of space (including the entranceway). It could provide space for three persons. The addition of a 4-foot length would provide for one more person.

Availability and Cost of Materials.—This type of shelter is available from steel culvert fabricators or their sales outlets in most population centers. This prefabricated shelter, including ventilation system, plastic wrap, and sandbags is designed to be sold for $150 or less, excluding delivery and installation.

Fallout Protection Factor.—When the entranceway is properly shielded as shown in the drawings, the protection factor should be greater than 500.

Blast Protection.—This shelter could be expected to withstand a limited blast overpressure of 5 pounds per square inch.

Ventilation.—A sheet metal intake vent 3 inches in diameter is provided together with a manual airblower for more than three persons. Air is vented through the sandbag closure at the entrance.

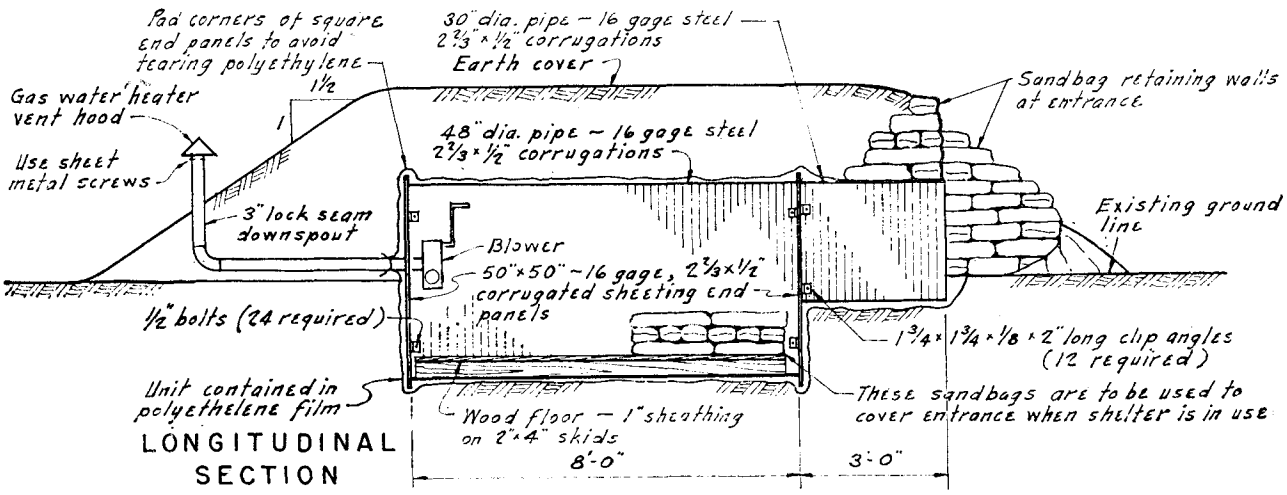
Installation Time.—One man working with hand excavation tools should be able to complete the excavation in less than 2 man-days. Two men will be needed to roll the shelter structure into the excavation from the point at which the shelter has been delivered. If lifting rather than rolling is necessary to transport the structure, four men will be required. Time for this phase will vary upward from 1 hour depending on distance of the move. It will then take one man 4 working days to complete the covering and installation phases.

Structural Life Expectancy.—The estimated life of this galvanized steel shelter will be at least 10 years under most soil conditions. Under normal conditions highway culverts of similar material have been known to last indefinitely with little maintenance.

CONSTRUCTION SEQUENCE*

1. Select well-drained site. The total area required, including the mounding, will be approximately 15′ x 20′.
2. Use stakes to mark the corners of the area, and excavate. The hole required for the main shell is 5′ x 9′ x 2′ deep, and the entrance requires an additional 2½′ x 4′ x 6″.
3. Line hole with plastic film wrap.
4. Lower galvanized steel shelter into place on supporting wood strips.
5. Assemble and install the vent pipe.
6. Cover shelter with plastic wrap.
7. Backfill and mound. Be sure the shelter is covered by at least 2 feet of packed earth. Depth may be checked with a wire probe. The mound should be covered with grass as soon as possible by sodding or seeding to prevent the protective soil from being eroded.
8. Place small sandbags inside the shelter. These are used to fill the entrance completely after the shelter is occupied.
9. 1-inch boards may be used on 2″ x 4″ blocks to provide a floor.

*This is a generalized construction sequence for a prefabricated steel culvert shelter. Detailed instructions are provided with the construction kit.

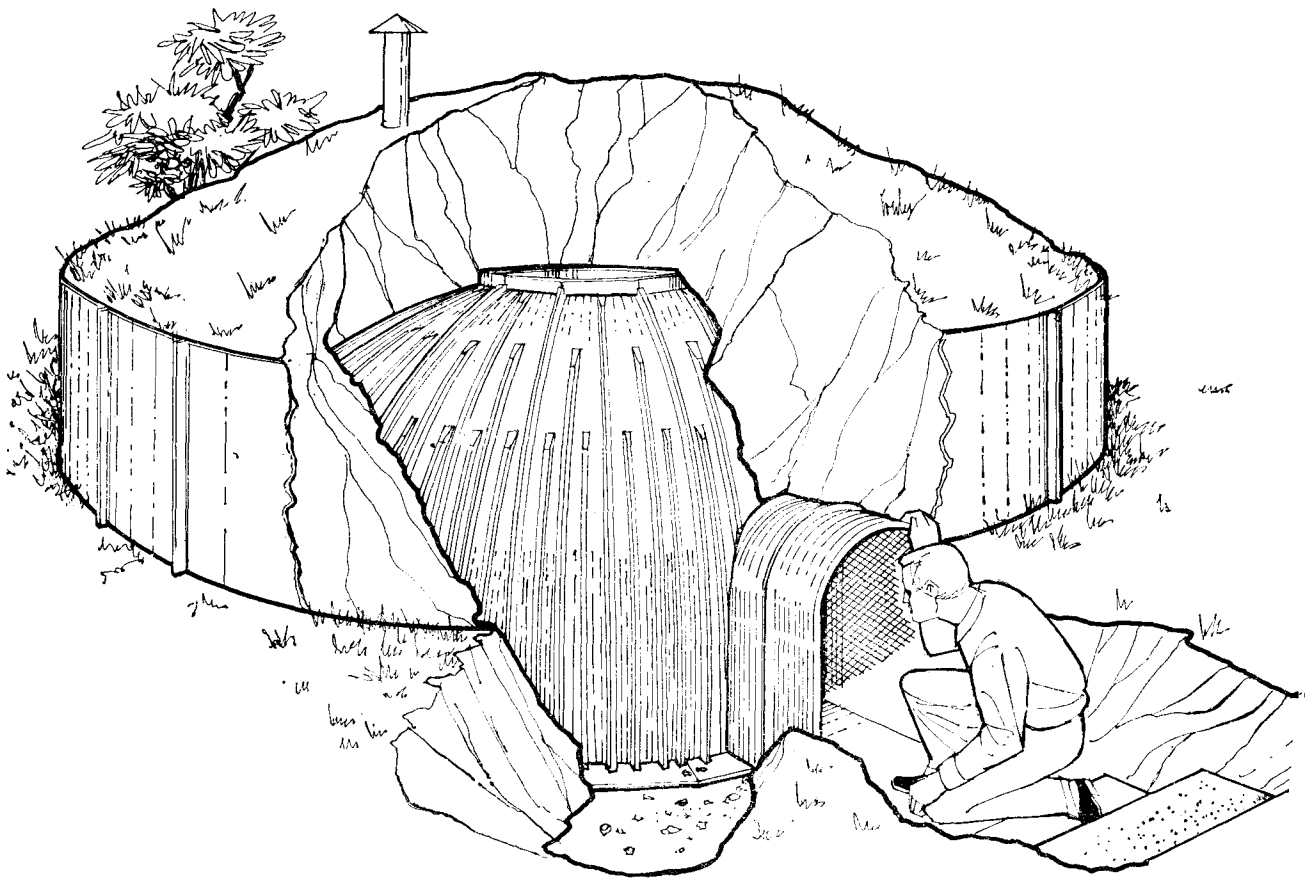


BILL OF MATERIALS
(To shelter 3 persons)

Item	*Quantity*
Prefabricated steel culvert shelter (with bolts and clips supplied, if unit is not spot welded).*	1.
Galvanized steel lock-seam downspout	6 feet.
Elbow for steel lock-seam downspout	1 foot.
Ventcap (gas water-heater type)	1.
Intake air blower (optional for 3 persons or less)	1.
Scrap lumber	9 board feet.
6 mil. polyethylene film (20′ width)	30 feet.
Sandbags (to hold 75 to 100 pounds each)	18.
Sandbags (to hold 15 to 20 pounds each)	30.
Flyscreen 7″ x 7″, for ventpipe	1.
Entranceway insect screen 36″ x 36″	1.
Soil or sand (for shelter cover)	5 tons.

*Fabricators should treat spot-welded areas with bitumastic compound or other approved waterproofing material.

Outside Semimounded Steel Igloo Shelter



GENERAL INFORMATION

This shelter is designed to provide low-cost protection from the effects of radioactive fallout. Its principal advantages are that it provides fallout and limited blast protection and is suitable for either indoor or outdoor installation, and is easily assembled.

TECHNICAL SUMMARY

Space and Occupancy.—The shelter type detailed in this design has about 80 square feet of area including the entrance space. The interior has about 260 cubic feet and will house six persons.

Availability and Cost of Materials.—This shelter is of the prefabricated type and is available at department stores, building supply outlets, and mail-order firms. Cost is about $175, not including installation or delivery.

Fallout Protection Factor.—The protection factor should be about 500 with the prescribed thickness of covering and proper shielding of the entranceway.

Blast Protection.—This shelter could be expected to withstand a limited blast overpressure of 5 pounds per square inch.

Ventilation.—Ventilation is provided by a 3-inch intake pipe to which should be attached a hand operated blower. The air is vented through the airspace left in the entranceway.

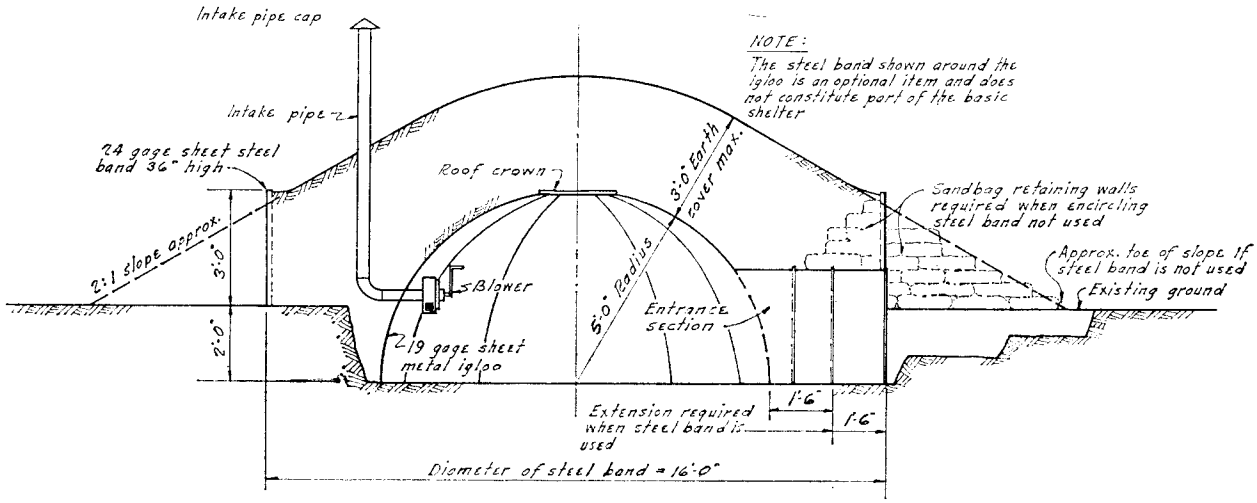
Construction Time.—The igloo steel shell requires 4 man-hours to assemble. Excavating and covering time should take 24 man-hours.

Structural Life Expectancy.—The igloo, when coated with mastic, has a life expectancy of at least 10 years.

CONSTRUCTION SEQUENCE*

1. Select well-drained site. The total area required, including the mounding, will be approximately 15′ x 20′.
2. Use stakes to mark the area, and excavate. The hole required for the main shell is 5′ x 12′ x 2′ deep, and the entranceway requires an additional 2½′ x 2′ x 6″.
3. Line hole with plastic film wrap.
4. Bolt one wall panel to the roof crown.
5. Bolt the next wall panel to the roof crown 180° from the first wall panel.
6. The third wall panel should be bolted to the crown and to a mating section. Repeat this step until all panels are bolted to mating panels and to the roof crown.
7. To complete the shelter, bolt the crawl entrance to the flanged lip on the entrance panel.
8. Cut 3″-diameter hole in wall opposite entrance. Mount ventpipe.
9. For outdoor installations, mound sand, earth, or bags of sand over the igloo shell to a covering height of 2 feet.
10. As an alternate installation in a basement, mound loose sand or sandbags to a covering height of at least 18 inches over the igloo shell.

*This is a generalized construction sequence for a prefabricated igloo shelter. Detailed instructions are provided with the construction kit.



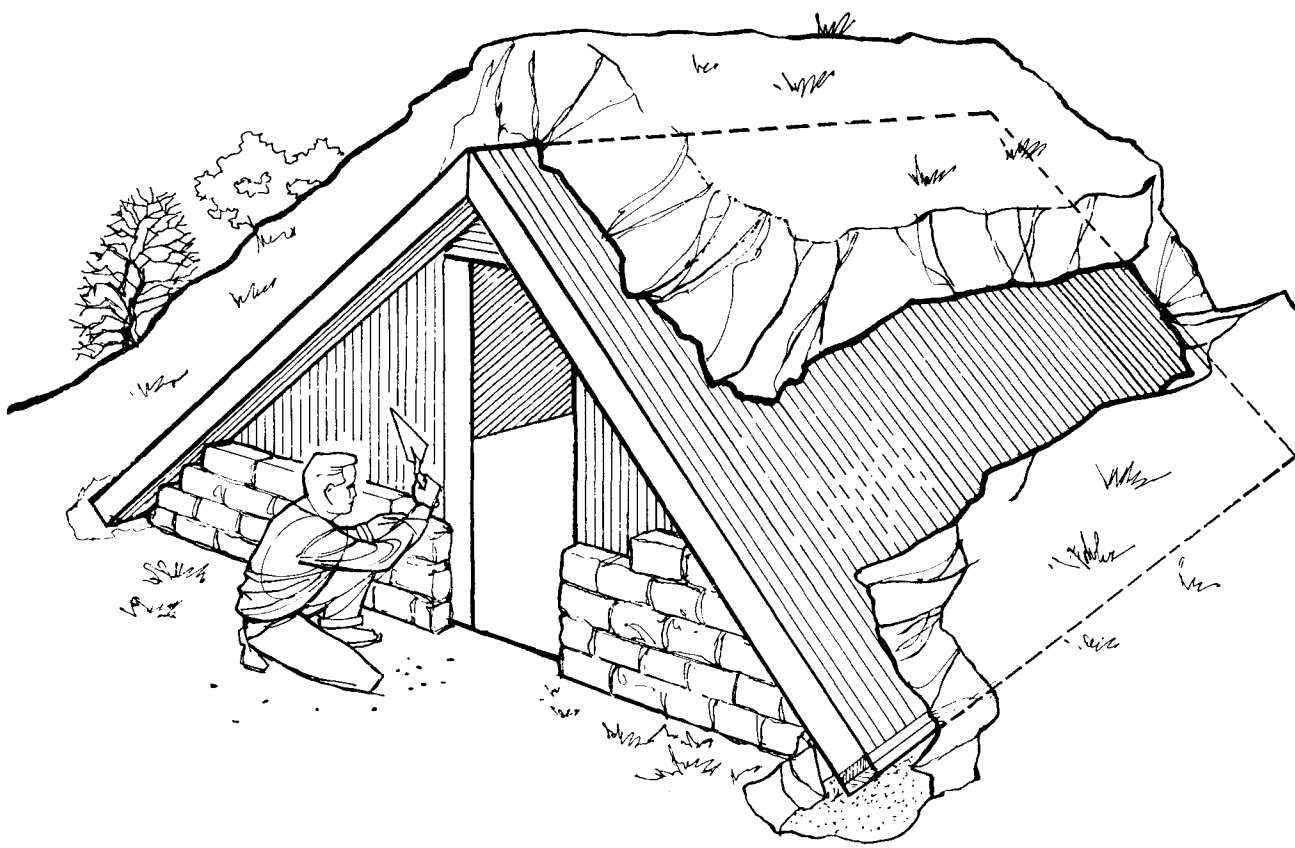
LONGITUDINAL SECTION

BILL OF MATERIALS

Item	*Quantity*
Roof crown	1.
Wall panels	11.
Wall panel, with entrance opening	1.
Entrance, crawlway and door	1.
Sand or soil for cover	15 tons.
6 mil. polyethylene film (20′ wide)	30 feet.
Mastic	6 gallons
Ventpipe (3″ diameter) with ventpipe cap	6 feet.
Hand-operated blower (20 cubic feet per minute)	1.
Flyscreen 7″ x 7″ for ventpipe	1.
(Nuts, bolts, washers—as required.)	
Sandbags (to hold 15 to 20 pounds each) for entrance and retaining walls.	50.
Sandbags (to hold 75 to 100 pounds each)	30.

FAMILY SHELTER SERIES PSD F–61–7

Aboveground Earth-Covered Lumber A-Frame Shelter

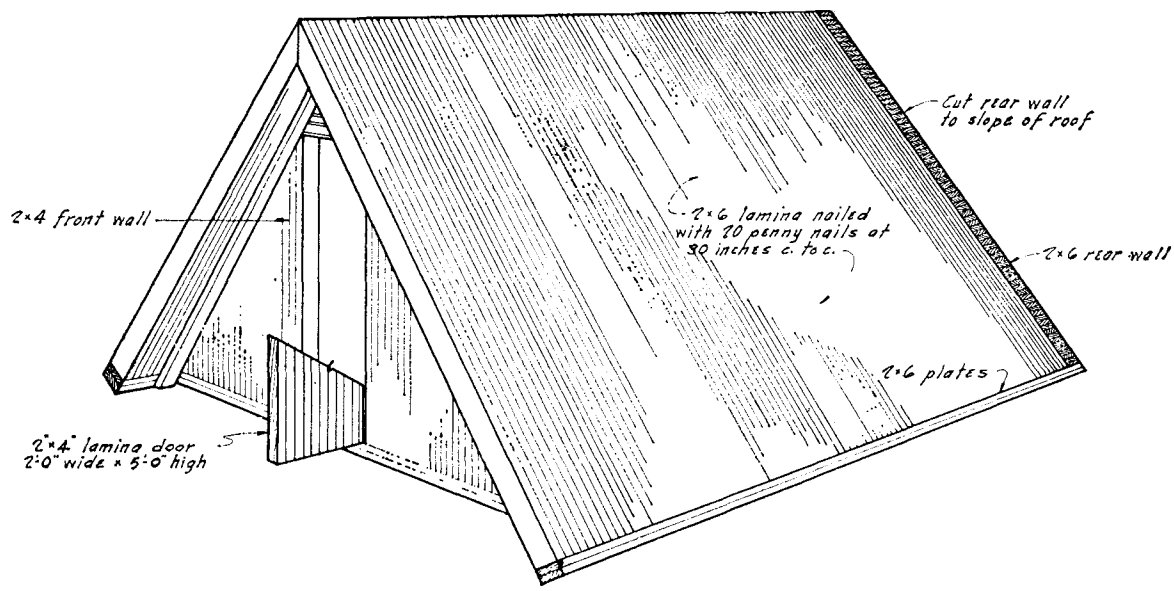


GENERAL INFORMATION

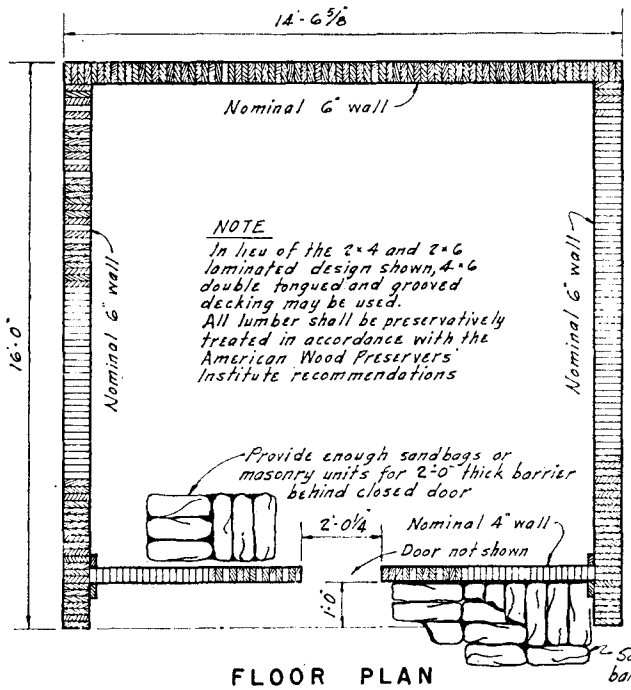
The purpose of this shelter is to provide protection for 10 persons from the effects of radioactive fallout at a location near but separate from a residence or other nearby buildings. The principal advantage of this shelter is that it can be erected without excavation in locations where there is poor drainage or where the ground water table is close to the surface. However, this shelter is not a low-cost structure. Footings or thrust ties are needed where the earth is soft or of poor bearing capacity.

TECHNICAL SUMMARY

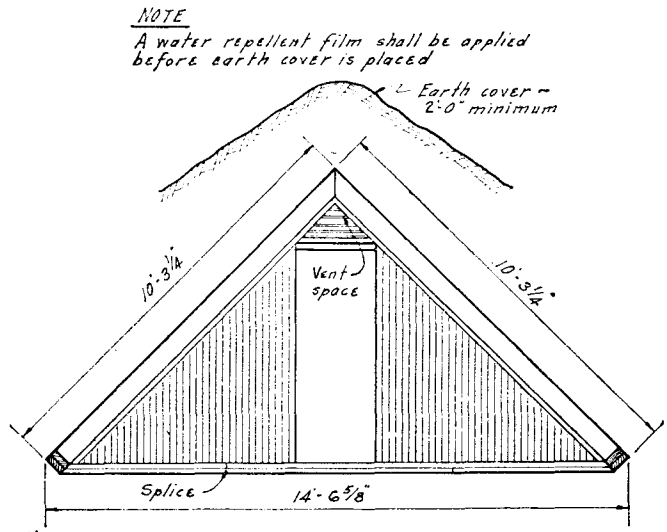
Space and Occupancy.—This shelter provides almost 150 square feet of area and approximately 640 cubic feet of space. Although only a small portion of this area provides sufficient headroom for standing erect, practically the entire area can serve as sitdown space for 10 persons and storage space for supplies.



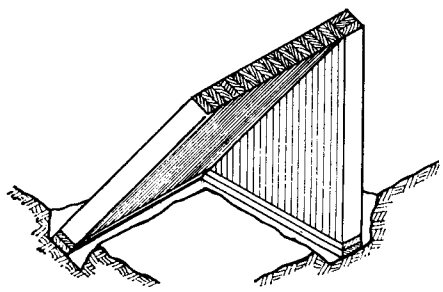
PERSPECTIVE VIEW



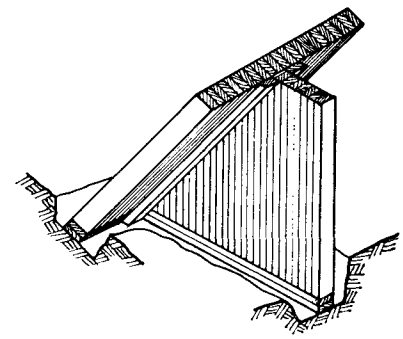
FLOOR PLAN



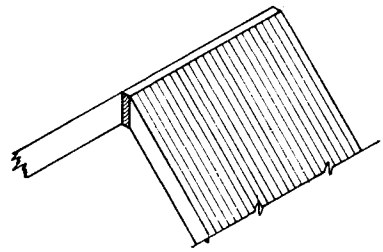
FRONT ELEVATION

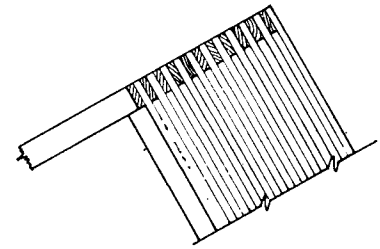


Rear Wall



Front Wall





Alternate Ridge Details

CONSTRUCTION DETAILS

Availability and Cost of Materials.—The pressure-treated lumber which is required is generally available at retail lumberyards. In certain areas it may be necessary to allow time for the treated lumber to be ordered and transported from stock at other locations. The estimated cost of materials is $550.

Fallout Protection Factor.—The recommended minimum earth cover of 2 feet with an entranceway and door shielded by a 2-foot thickness of sandbags, and the rear wall mounded will provide a protection factor of about 500.

Blast Protection.—While the basic function of this shelter is fallout protection, limited blast resistance of about 5 pounds per square inch of overpressure would be afforded by the heavy wood structure. The blast resistance would vary somewhat with the workmanship and materials but the laminated design tends to offset variations.

Ventilation.—Ducts for mechanical ventilation may be located in the ventspace over the doorway without involving structural change. Hand-operated ventilation equipment should be used.

Construction Time.—After materials are delivered at the jobsite, 4 man-days should be allowed for erecting the structure. Earth covering would require 4 additional man-days, without the use of power equipment.

Structural Life Expectancy.—The life expectancy of this shelter should be from 15 to 20 years.

CONSTRUCTION SEQUENCE

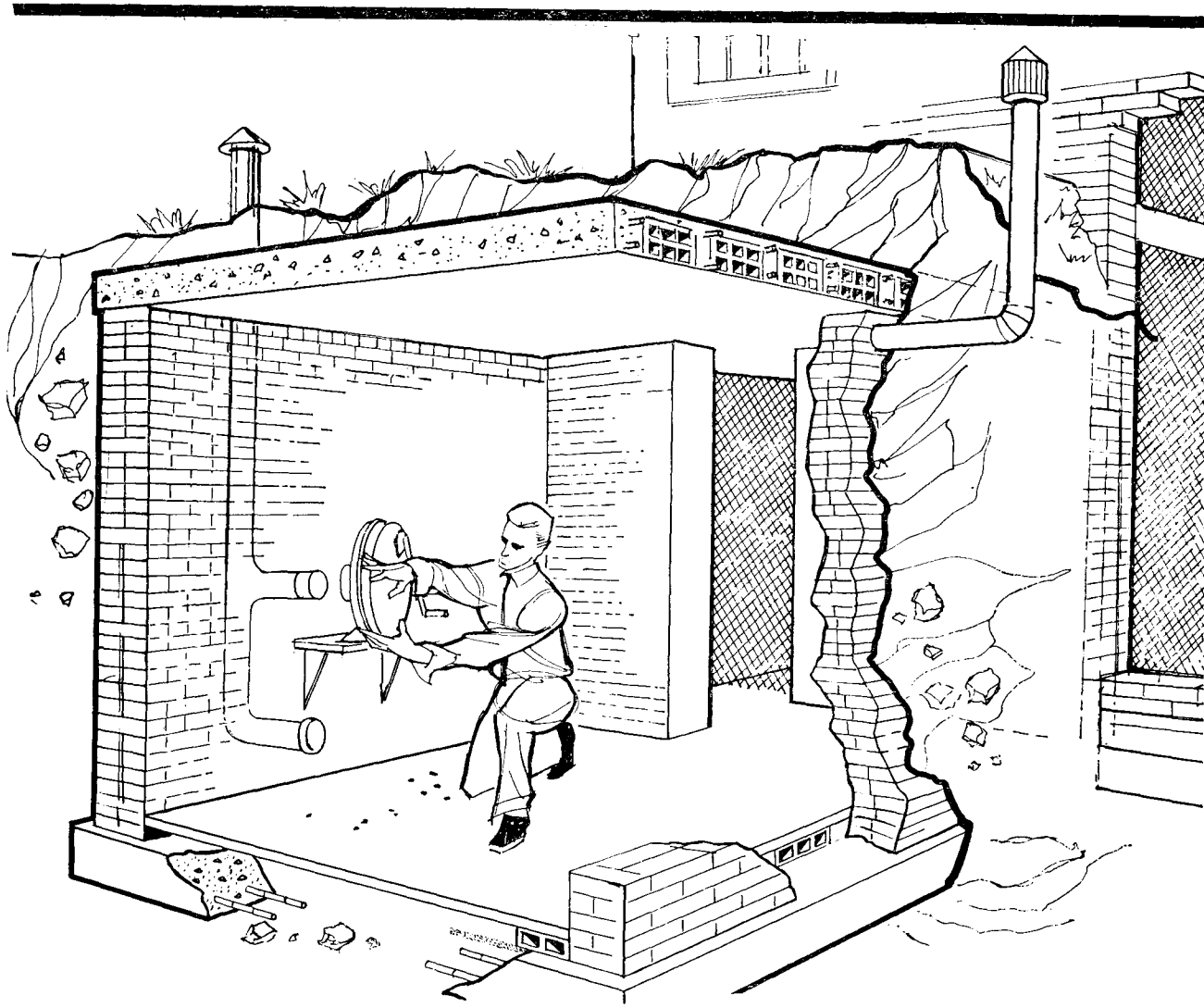
1. Assemble the materials at the shelter site.
2. Trench to subsoil for the wallplates as shown on the floor plan and details. Assemble plates in the trenches. (See construction details, rear-front walls.)
3. Begin at either end and erect roof wall members in pairs. (See alternate ridge details.) Progress to the opposite end, spiking laminations together. If 2″ x 6″ lamina are used, they should be nailed with twentypenny nails at approximately 30-inch spacing. If 4″ x 6″ decking lamina are used, they should be fastened together with $\frac{5}{16}$-inch diameter spikes at approximately 30-inch spacing.
4. Erect the end walls as shown on the drawings with ends of the lamina cut flush with the roof wall top surface. The lamina should be spiked together in the same manner as the roof members.
5. The supporting structure is now complete. It should be covered with the polyethylene film and covered with earth. The earth cover should be started at the base of the roof walls and applied evenly to both sides. Next mound earth against the rear wall. The sandbags or masonry blocks are applied on both sides of the front wall to a thickness of 2 feet. A supply of filled sandbags or blocks should be stored inside the shelter to add to the protection afforded by the door.
6. Vegetation, riprap, or other means of holding the soil in place should be provided.
7. A duct for air intake will be required with the installation of the hand-operated blower. The intake duct may be located in the rear wall of the shelter and the air can be exhausted through the louvered ventspace over the doorway.
8. The door may be of heat- or blast-resistant construction, as manufactured commercially, or may be contrived by nailing 2″ x 4″ studs together to make a 4-inch-thick door. This then can be mounted with ordinary hinges and should be painted white.

BILL OF MATERIALS

Item	*Quantity*
Roof walls 2″ x 6″ x 10′	250 pieces.
Rear wall 2″ x 6″ x 8′	50 pieces.
Front wall 2″ x 4″ x 8′	40 pieces.
Plates:	
2″ x 6″ x 10′	10 pieces.
2″ x 4″ x 10′	3 pieces.
Fastenings:	
Fortypenny nails	10 pounds.
Twentypenny nails	30 pounds.
Water repellent—building felt or plastic film	150 square feet.
Bagged earth or masonry blocks for front wall shielding.	600 filled sandbags (30 pounds) or 176 concrete blocks (8″ x 12″ x 16″).
Blower, manually operated (rated at 30 cubic feet per minute).	1.
Intake pipe, galvanized (to be mounted through rear wall).	6 feet.
Flyscreen 7″ x 7″ (for intake pipe)	1.
Flyscreen 24″ x 24″ (to cover ventspace over door)	1.

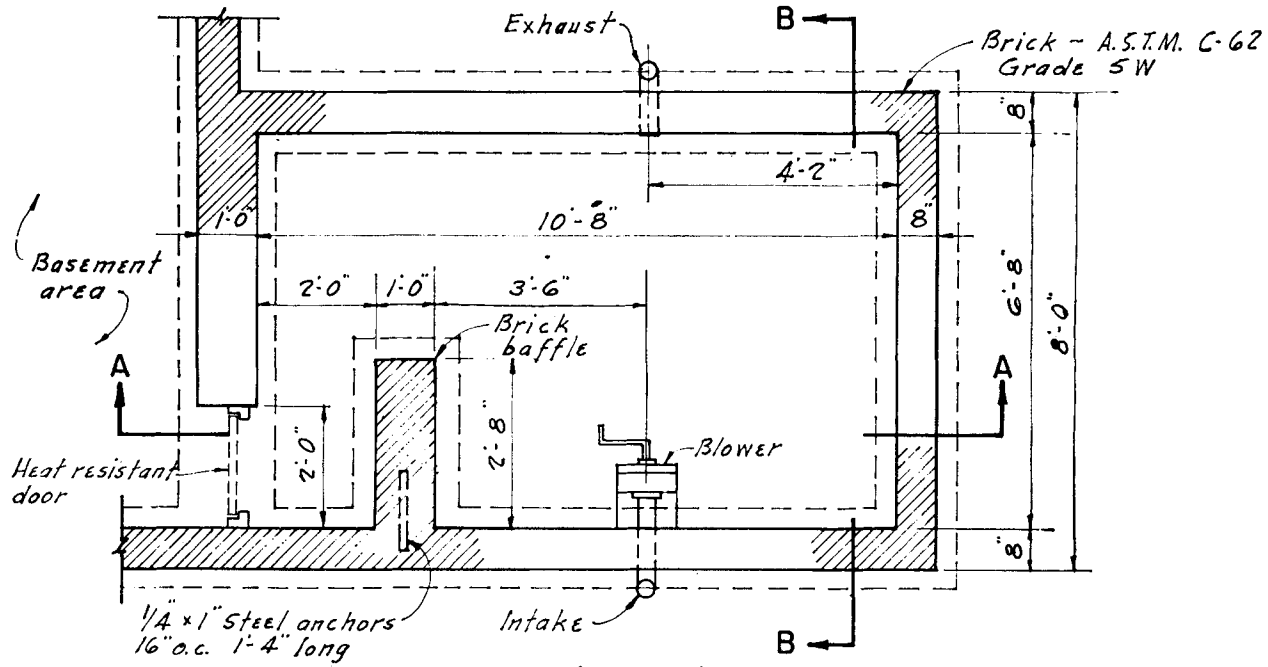
FAMILY SHELTER SERIES PSD F-61-8

Belowground New Construction Clay Masonry Shelter

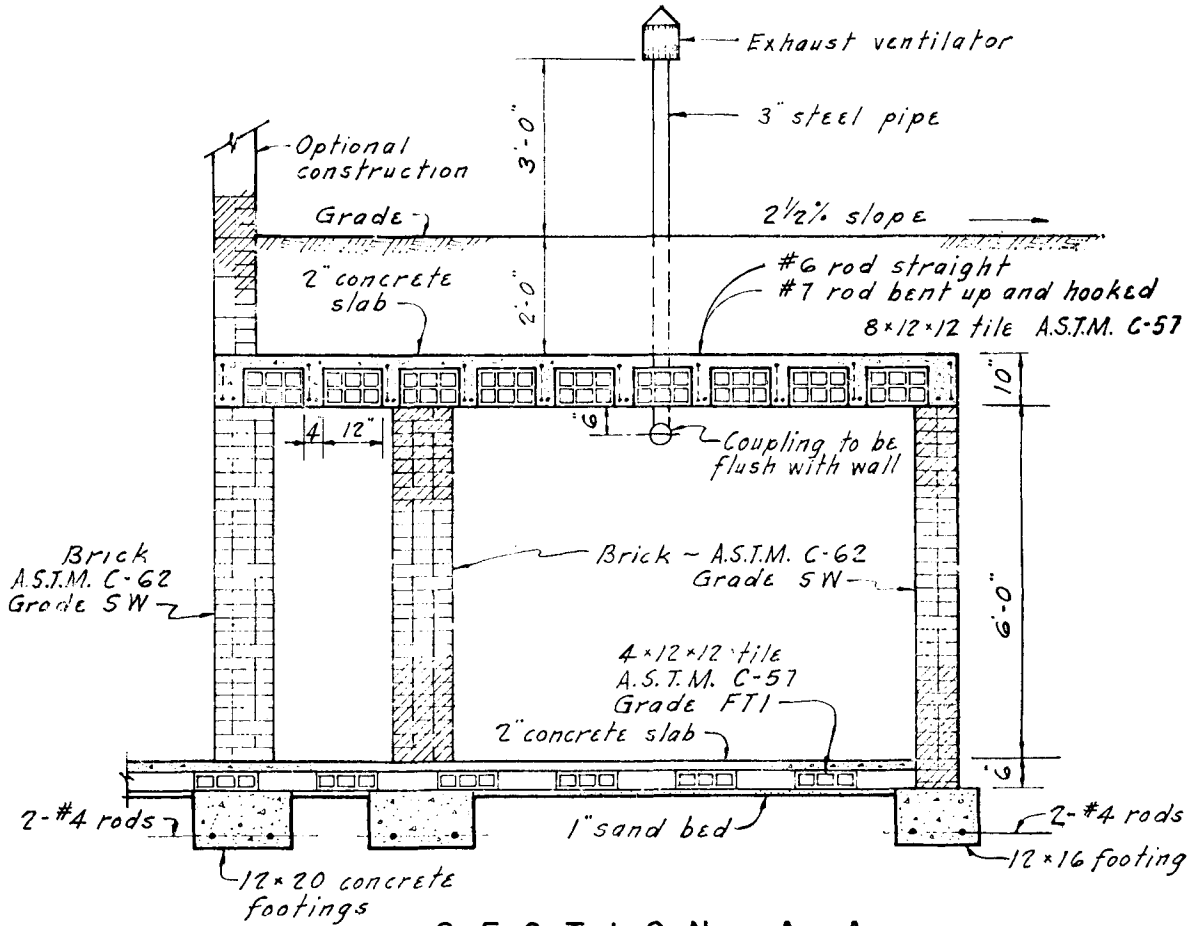


GENERAL INFORMATION

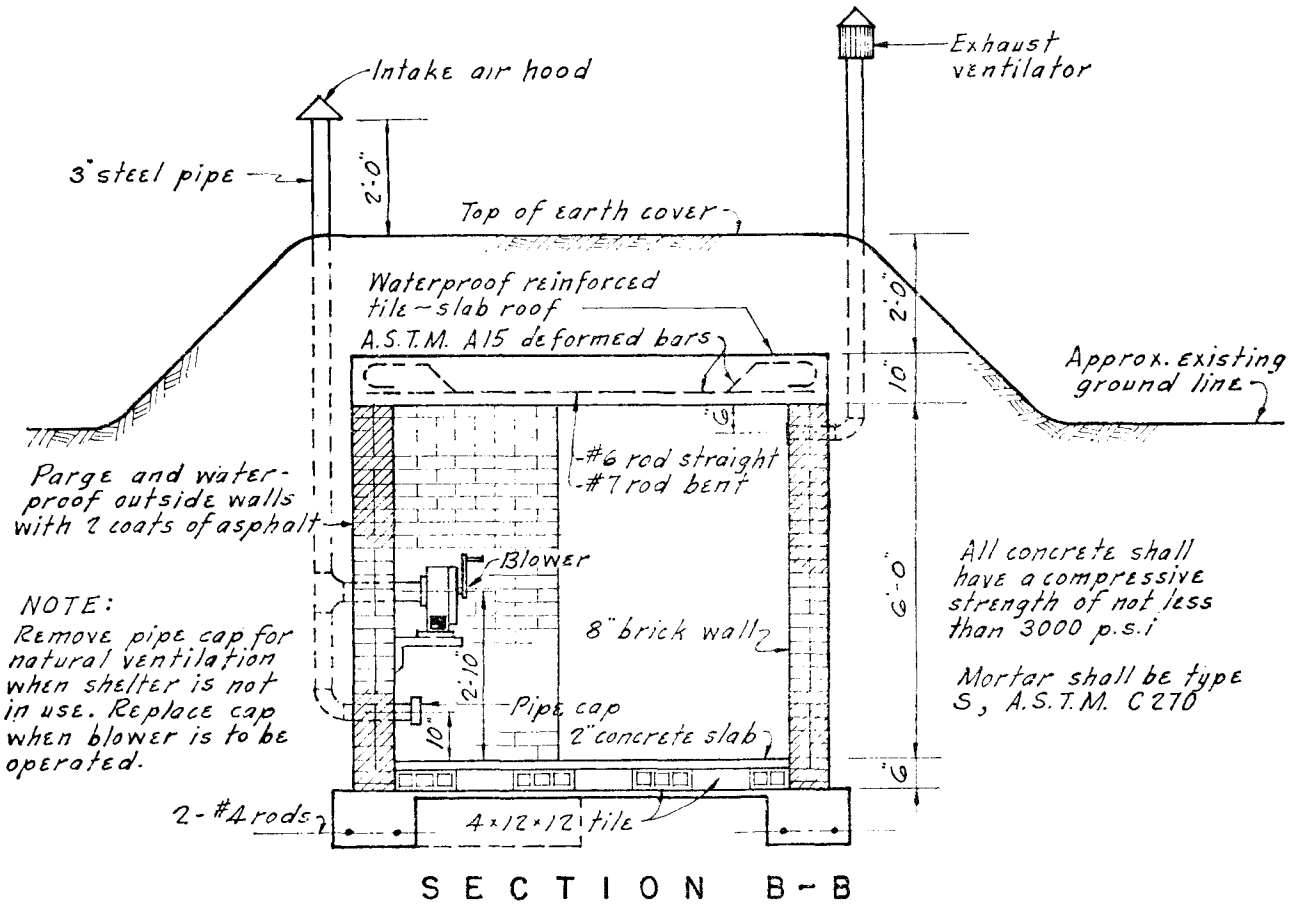
This shelter will provide protection against the effects of radioactive fallout. It can also protect from limited blast overpressures. The shelter is located belowground outside a house but is reached from the basement. Its principal advantages are in flexibility of shape and design to conform to the house design and in the use of materials that tie in with the new construction of a house. Because of the headroom and interior space the shelter can be used for other purposes.



PLAN



SECTION A-A



SECTION B-B

TECHNICAL SUMMARY

Space and Occupancy.—The shelter in this design has over 70 square feet of area and 420 cubic feet of space. It will provide occupancy for six persons.

Availability and Cost of Materials.—Structural clay masonry units, brick, and structural tile are available at your local building materials supplier. Cost of the materials and equipment for the basic shelter is estimated at $300 to $350. Labor cost should run approximately $250 to $300 when performed as part of new house construction.

Fallout Protection Factor.—The protection factor for a shelter of this type is over 1000.

Blast Protection.—This shelter has a structural blast resistance of 5-pounds-per-square-inch overpressure.

Ventilation.—Ventilation equipment and pipe are required. A hand-operated blower should be specified to furnish at least 20 cubic feet of air per minute. The air is exhausted through a separate ventpipe.

Construction Time.—A home-construction project that includes this shelter will not require additional trades or crafts not already on the project. The time for construction of this shelter could increase normal house construction time by a few days.

Structural Life Expectancy.—Assuming normal construction practices, this structure, with a minimum of maintenance, should last more than 30 years.

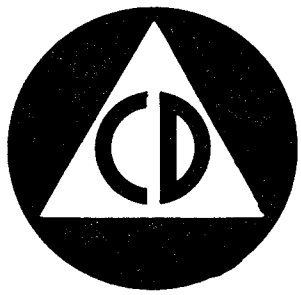
CONSTRUCTION SEQUENCE

No construction sequence is given for this shelter because the work would probably be supervised by a contractor familiar with new construction.

BILL OF MATERIALS

Item	*Quantity*
Roof:	
8″ x 12″ x 12″ structural clay tile ASTM–C57—grade FTI.	72 pieces.
Steel reinforcing, No. 6 deformed bars 7′6″ length, ASTM–A–15—Straight.	10 pieces.
Steel reinforcing, No. 7 deformed bars 10′ length, bent up and hooked ASTM–A–15.	10 pieces.
Concrete, minimum 3,000 pounds per square inch	1.5 cubic yards.
Walls:	
Brick, standard size (2⅔″ x 4″ x 8″) ASTM–C62—grade SW.	3,800 pieces.
Anchors (¼″ x 1″ x 4″) steel	4.
Mortar (1–¼–3¾ cement-lime-sand)	65 cubic feet.
Floor:	
Tile (4″ x 12″ x 12″) structural clay ASTM–C57—grade FTI.	96 pieces.
Concrete, minimum 3,000 pounds per square inch	0.7 cubic yard.
Footings:	
Concrete, minimum 3,000 pounds per square inch	1.0 cubic yard.
Steel reinforcing, No. 4 reinforcing bars ASTM–A15	68 linear feet.
Miscellaneous:	
Parge 1–¼–3¾ mortar ASTM–C270—Type M	8 cubic feet.
Asphalt	5 gallons.
Blower (at least 20-cubic-feet-per-minute rating)	1.
Mounting bracket, blower	1.
Intake and exhaust ventpipe, 3″ steel (sufficient for both intake and vent pipes).	16 linear feet.
Fittings:	
Ells 3″ steel	2.
Tees 3″ steel	1.
Ventpipe cap	1.
Flyscreen 7″ x 7″ (for vent and intake pipes)	2.

U.S. GOVERNMENT PRINTING OFFICE: 1962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